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FROM

Commonwealth of Pennsylvania.

REPORT

OF THE

WATER SUPPLY COMMISSION

OF

PENNSYLVANIA

1912

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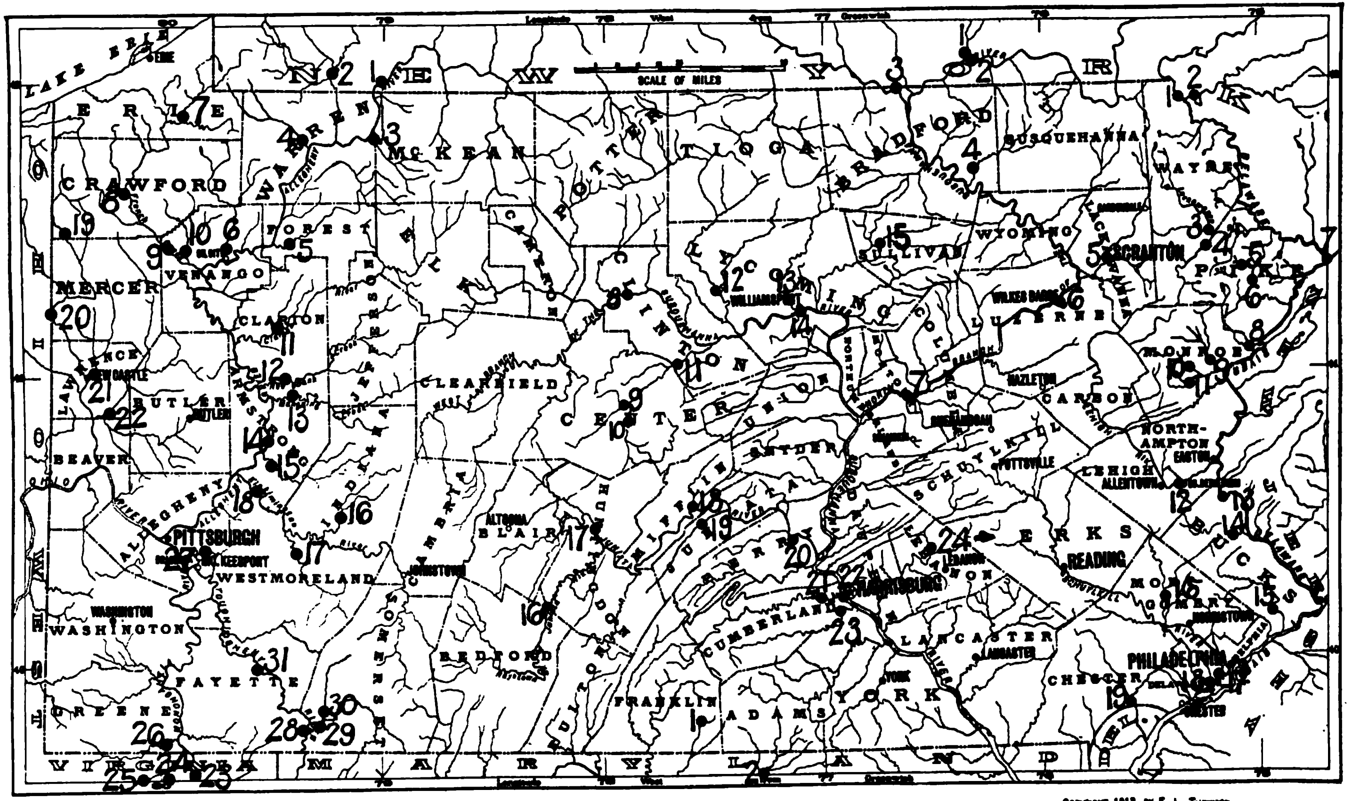
MAP SHOWING LOCATION

—OF—

GAGING STATIONS

1912



Water Supply Commission of Pennsylvania, Harrisburg, Pa

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WATER SUPPLY COMMISSION OF PENNSYLVANIA

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* * *

LETTER OF TRANSMITTAL.

Office of the Water Supply Commission of Pennsylvania,
Harrisburg, Pa., December 31, 1912.

To His Excellency, the Governor of the Commonwealth of Pennsylvania:

To the Members of the Senate and House of Representatives of the Commonwealth of Pennsylvania:

In compliance with the provisions of the Act of the General Assembly, approved May 4th, 1905, the Water Supply Commission respectfully submits its report for the year 1912.

JOHN BIRKINBINE,
Chairman.

FREDERICK W. FLEITZ,
Vice-Chairman.

THOMAS J. LYNCH,
Secretary.

ROBERT S. CONKLIN,
Commissioner of Forestry.

SAMUEL G. DIXON,
Commissioner of Health.

REPORT

OF THE

WATER SUPPLY COMMISSION OF PENNSYLVANIA

1912

CHAPTER I

GENERAL REPORT

The Commission has during the year approved thirty-four applications for the incorporation of water and water power companies, two agreements of merger, and one sale of property and franchises. Table No. 1 shows the number of companies incorporated, with the approval of the Commission, and the present status thereof.

TABLE NO. 1.

Present Status of Water Companies Incorporated Between May 4th, 1905, and January 1st, 1913.

Year.	Number incorporated.	In Operation.		Under Construction.		Not Operating.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
1905,	6	4	67	0	0	2	33
1906,	30	22	73	0	0	8	27
1907,	33	21	64	1	3	11	33
1908,	20	12	60	0	0	8	40
1909,	38	25	66	4	10	9	24
1910,	26	17	66	3	11	6	23
1911,	28	18	64	1	4	9	32
1912,	36	15	42	1	3	20	55
Total and equivalent per cent.,	217	134	63	10	4	73	33

Of the new companies formed eleven are for domestic water supply, four for industrial supply, and twenty-one are for the generation of water power. Interest in the development of the water power of the State is evidenced by the number of water power charters granted; but, although twenty-one charters were approved, only three distinct water power operations are involved, one requiring thirteen and another seven charters to cover the desired territory, the former contemplating the complete development of an important river. Another involves the complete development and utilization of a secondary stream, by means of three high dams and storage reservoirs. Throughout the country hydro-electric development is becoming a prominent factor in industrial advancement; public service is improved, manufacturing increased, and population augmented through the more abundant and cheaper power resulting from such works, where properly constructed and controlled.

Tables Nos. 2, 3 and 4 show, respectively, the water and water power companies incorporated in 1912, those companies which are operating, source of supply and character of works, and the consolidations effected among water and water power companies during 1912.

TABLE NO. 2.

Water and Water Power Companies Incorporated in 1912.

Name.	Date of Incorporation.	Territory Covered by Charter.	Status.
1. Barnett Water Power Co.,	May 1, 1912,	Barnett Township, Jefferson Co.,	Merged into Clarion River Power Company.
2. Central Brodheads Power Co.,	April 29, 1912,	Stroud Township, Monroe Co.,	Active.
3. Chinchilla Water Co.,	Dec. 2, 1912,	Chinchilla Village, Lackawanna Co.,	Active.
4. Clarion River Power Co.,	June 7, 1912,	Merger—Clarion, Elk, Jefferson, Forest,	Not in operation.
5. Clarion River Power Co.,	May 1, 1912,	Clarion Township, Clarion Co.,	Merged into Clarion River Power Company.
6. Cloe Water Co.,	Dec. 9, 1912,	Bell Township, Jefferson Co.,	Active.
7. Cummings Water Co.,	Dec. 9, 1912,	Rayne Township, Indiana Co.,	Active.
8. East Donegal Township Water Co.,	Nov. 13, 1912,	Portion of E. Donegal Township, Lancaster Co.	Active.
9. Farmington Water Power Co.,	May 1, 1912,	Farmington Township, Clinton Co.,	Merged into Clarion River Power Company.
10. Forrest Water Power Co.,	May 1, 1912,	Barnett Township, Forest Co.,	Merged into Clarion River Power Company.
11. Gravity Water Co.,	June 28, 1912,	Addison Township, Somerset Co.,	Not in operation.
12. Heath Water Power Co.,	May 1, 1912,	Heath Township, Jefferson Co.,	Merged into Clarion River Power Company.
13. Highland Water Power Co.,	May 1, 1912,	Highland Township, Clarion Co.,	Merged into Clarion River Power Company.
14. Hooversville Water Co.,	Jan. 12, 1912,	Hooversville Borough, Somerset Co.,	Under construction.
15. Houston Water Co.,	July 22, 1912,	Houston Borough, Washington Co.,	Active.
16. Ketner Water Co.,	Dec. 9, 1912,	Jones Township, Elk Co.,	Active.
17. Kittanning Water Power Co.,	May 10, 1912,	Armstrong and Indiana Counties,	Not in operation.
18. Kyle Water Co.,	Dec. 9, 1912,	Washington Township, Jefferson Co.,	Active.
19. Licking Water Power Co.,	May 1, 1912,	Licking Township, Clarion Co.,	Merged into Clarion River Power Company.
20. Lower Brodheads Power Co.,	April 29, 1912,	Smithfield Township, Monroe Co.,	Active.
21. Manheim Township Water Co.,	April 1, 1912,	Manheim Township (portion of), Lancaster Co.	Active.
22. Mar Lin Water Co.,	Nov. 19, 1912,	Norwegian Township, Schuylkill Co.,	Not in operation.
23. Middle Brodheads Power Co.,	April 29, 1912,	Stroudsburg Borough, Monroe Co.,	Active.
24. Mill Creek Water Power Co.,	May 1, 1912,	Mill Creek Township, Clarion Co.,	Merged into Clarion River Power Company.
25. Millstone Water Power Co.,	May 1, 1912,	Millstone Township, Elk Co.,	Merged into Clarion River Power Company.
26. Monroe Water Power Co.,	May 1, 1912,	Monroe Township, Clarion Co.,	Merged into Clarion River Power Company.
27. Paint Township Water Power Co.,	May 1, 1912,	Paint Township, Clarion Co.,	Merged into Clarion River Power Company.
28. Perry Water Power Co.,	May 1, 1912,	Perry Township, Clarion Co.,	Merged into Clarion River Power Company.
29. Pure Mountain Water Co.,	June 28, 1912,	Black Township, Somerset Co.,	Not in operation.
30. Riceville Power Co.,	June 28, 1912,	Riceville Township, Crawford Co.,	Not in operation.
31. Richland Water Power Co.,	May 1, 1912,	Richland Township, Clarion Co.,	Merged into Clarion River Power Company.
32. Shohola Falls Hydro-Electric Co.,	Jan. 12, 1912,	Shohola Township, Pike Co.,	Not in operation.
33. South Strabane Water Co.,	Aug. 26, 1912,	South Strabane Township, Washington Co.,	Active.
34. Upper Brodheads Power Co.,	April 29, 1912,	East Stroudsburg Borough, Monroe Co.,	Active.
35. West Norriton Water Co.,	April 29, 1912,	West Norriton Township, Montgomery Co.,	Active.
36. Williamsport Water Co.,	Jan. 12, 1912,	Merger of Williamsport Water Co. and the Citizens' Gas and Water Co. of Williamsport.	Active.

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STREAM ENCROACHMENTS.

The Act of May 28th, 1907, by the terms of which the Commission exercises jurisdiction over encroachments on streams, has been the subject of an opinion by the Attorney General (see page 19), by which the powers and duties of the Commission are interpreted to extend over more classes of streams than the text of the Act seemed to the Commission to indicate, thereby augmenting this feature of the Commission's work, with corresponding benefit to the streams of the State. During 1912 forty-eight applications for encroachments on streams received approval, including twenty-eight bridges, eight dams, eleven fills and walls, and one change of channel location. The Commission has undertaken a general enforcement of this law by establishing an efficient information system through which early knowledge is obtained of proposed work of this character, and by giving prompt as well as thorough attention to such applications; for where encroachments are planned in such manner as to receive approval the applicants should receive notice thereof with dispatch.

The following table exhibits the number of applications granted in this branch of the Commission's work, each year, since the passage of this Act:

TABLE NO. 5.

Encroachments on Streams Approved By Water Supply Commission.

Year.	Number.
1908,	19
1909,	27
1910,	32
1911,	32
1912,	48
Total,	158

The prospects are that the number of encroachments coming under supervision of the Commission will be larger than in 1913 than heretofore, and may require an increase in the force to expeditiously dispose of them. The public is becoming more cognizant of, and broader recognition is being given to, the Commission's jurisdiction over such matters.

Owing to the fact that the jurisdiction of the Commission over encroachments in certain streams under the Act of May 28th, 1907, had been questioned, the Attorney General was requested to give his official opinion as to what streams come within the definition of the Act. This opinion is found below.

OFFICE OF ATTORNEY GENERAL.

Harrisburg, November 12, 1912.

T. J. Lynch, Esq.,
Secretary, Water Supply Commission of Pennsylvania.
Harrisburg, Pa.

Dear Sir:—This Department is in receipt of your inquiry of October 11th, 1912, in which you state, in substance, that the Water Supply Commission requests an official opinion as to its jurisdiction under the Act of May 28th, 1907, P. L. 299, entitled:

> "An Act to provide that no dam, wall, wing-wall, wharf, pier, embankment, abutment, projection, or other obstruction, nor any addition thereto, shall be constructed, erected, or built in or along any public or navigable river, or stream heretofore declared a public highway, within this Commonwealth; nor shall the course, current or cross section thereof be changed or diminished, without the approval of the Water Supply Commission of Pennsylvania; and to require maps, plans, profiles, specifications, information, and data relating thereto to be submitted to said Commission."

You ask, in substance, to be advised whether the jurisdiction of the Commission extends to, first, all public rivers; second, all navigable rivers, and, third, all streams heretofore declared public highways; or whether it is confined to streams which have been declared public highways by an Act of Assembly.

The language of this Act is that:

> "No person or persons, corporation, county, city, borough, or township shall construct, erect, or build, *in or along any public or navigable river, or stream heretofore declared a public highway,* within this Commonwealth, any dam, wall, wing-wall, wharf, pier, etc., * * * unless and until the said person or persons, corporation, county, city, borough, or township shall have submitted to the Water Supply Commission of Pennsylvania complete maps, plans, profiles, etc., * * * and a majority of the members of the said Water Supply Commission of Pennsylvania shall have approved the same."

You illustrate your inquiry by citing the fact that the Western Maryland Railroad Company has recently constructed a new line along the Youghiogheny and Casselman rivers, from New Haven southward to the State line, and has made numerous encroachments on these streams. In so far as the Youghiogheny river is concerned, you state that the corporation has made application to the Commission for its approval of such encroachments, but refuses to make application with respect to the Cassleman river, upon the ground that the Cassleman river has not been declared a public highway, and therefore does not come within the jurisdiction of the Commission.

The Commission, by the express language of the Act, is given jurisdiction for the purposes specified in the Act, over "any public or navigable river, or stream heretofore declared a public highway."

You state in your communication that it is contended by counsel for several corporations that the phrase "heretofore declared a public highway" relates to and modifies the words "any public or navigable river," as well as the word "stream," and that the Commission, therefore, has no jurisdiction over any river or stream unless such river or stream has been declared a public highway by the Act of Assembly. Your Commission was created by the Act of May 4th, 1905, P. L. 385, and authorized, inter alia, to adopt ways and means of utilizing, conserving, purifying and distributing the water supplies of this State in such a way that the various communities of the State shall be fairly and equitably dealt with in such distribution. The powers conferred by the above cited Act of 1907, are in addition to the general powers conferred by the Act creating the Commission, and the general purpose in conferring these additional powers is to protect the rights of the public in the rivers and streams of the Commonwealth from encroachments by individuals, private corporations and municipalities. It therefore becomes necessary for us to ascertain as accurately as possible what is meant by, and included within, the descriptions "public river," "navigable river," and "stream heretofore declared a public highway," and to investigate the rights of the public in these different classifications of the waters of the Commonwealth. There is no difficulty in distinguishing between a public river and a private river. In the case of Coovert vs. O'Connor, 8 Watts, 470, it is said that:

> "All rivers, lakes and streams comprehended within the charter bounds of the province, passed to William Penn in the same manner as the soil. In grants of tracts of vacant lands by him or his successors during the proprietary times, and by the Commonwealth since, streams not navigable falling within the lines of a survey, were covered by it and belonged to the owner of the tract, who might afterwards convey the body of the stream to one person and the adjoining land to another."

Such streams are properly described as "private rivers," and it is held in the case cited, and in other cases, that when a grant or survey is bounded by such river or creek, the title of the grantee extends to the middle of the stream. The phrase "not navigable" in the foregoing quotation, is evidently used in a limited and qualified sense and is intended by the author to distinguish the streams therein referred to from large navigable streams.

On the other hand, it is held in the case of the Barclay Railroad and Coal Company vs. Ingham, 36 Pa. 194, that "in respect to the great rivers of the State, such as are navigable by nature and there fore public highways by the common law" * * * that these rivers are, properly speaking, public rivers, the soil of which has never been granted to private owners either by William Penn, his successors, or the Commonwealth. With respect to such rivers the following language is used in the above cited case:

> "The rivers, and the beds of the rivers belonged to the Commonwealth and constituted part of the eminent domain. Private surveys bounding on them were stopped at low water mark."

Thus far the distinction is plain. A river navigable by nature, the ownership of the bed of which remains in the Commonwealth, is a public river, and a public highway at common law. Speaking of such rivers, Chief Justice Tilghman, in Shrunk vs. Schuylkill Navigation Company, 14 S. & R. 71, said:

> "It is unnecesary to enumerate at this time the rivers which may be called principal, but that name may be safely given to the Ohio, Monongahela, Youghiogheny, Allegheny, Susquehanna, and its north and west branches, Juniata, Schuylkill, Lehigh and Delaware."

A river, the title to the bed of which has been granted by the Commonwealth to private owners, whether navigable in fact or not, is a private river. If such private river is navigable in fact, the public has an easement therein for purposes of transportation and commercial intercourse. The word "navigable" is elastic and somewhat indefinite in its meaning. As stated in Barclay Railroad and Coal Company vs. Ingham, supra, it may mean "an ascending, as well as descending navigation by boats of considerable burden—or merely a descending navigation by arks and rafts at all seasons—or by arks and rafts in seasons of freshets."

Under the English common law only such streams as were affected by the ebb and flow of the tides were deemed navigable streams. This criterion never obtained in America, as appears from the decision of our Supreme Court in the above cited case of Barclay Railroad & Coal Company vs. Ingham. In the course of the opinion in that case, Mr. Justice Woodward said:

> "In England those streams only are called navigable in which the tides ebb and flow, but with us all our public rivers, whether fresh or salt, are navigable; and hence, a very erroneous idea has sprung that such rivers only are public highways, and that, in the lesser streams, granted by the Commonwealth to purchasers, the public have no rights until they are declared by law to be highways."

It also appears from the opinion in that case, that even in England, from the days of Magna Charta the public had an easement

TABLE NO. 3.

Water and Water Power Companies Incorporated in 1912 Which are in Operation.

Name.	Supplies.	Source of Supply.	System of Supply.
1. Central Broadheads Power Co.,	Stroud Township, Monroe Co.,	Brodheads Creek,	Water power.
2. Chinchilla Water Co.,	Chinchilla Village, Lackawanna County,	Drilled wells,	Pumping.
3. Cloe Water Co.,	Bell Township, Jefferson County,	Jackson run,	Gravity.
4. Cummings Water Co.,	Rayne Township, Indiana County,	Getty run,	Gravity.
5. East Donegal Township Water Co.,	Portion of Florin, Lancaster County,	Drilled well,	Pumping.
6. Houston Water Co.,	Houston Borough, Washington County,	Canonsburg, Wyoming County,	Pumping.
7. Ketner Water Co.,	Jones Township, Elk County,	Johnson run,	Gravity.
8. Kyle Water Co.,	Washington Township, Jefferson County,	Kyle run,	Gravity.
9. Lower Brodheads Power Co.,	Smithfield Township, Monroe County,	Brodheads creek,	Water power.
10. Manheim Township Water Co.,	Portion of Manheim Township, Lancaster Co.,	Lancaster water works,	Pumping.
11. Middle Brodheads Power Co.,	Stroudsburg, Monroe County,	Brodheads creek,	Water power.
12. South Strabane Water Co.,	South Strabane Township, Washington County,	Citizens' Water Co., Washington County,	Pumping.
13. Upper Brodheads Power Co.,	East Stroudsburg, Monroe County,	Brodheads creek,	Water power.
14. West Norton Water Co.,	Portion of West Norton Township, Montgomery County.	Norristown Insurance & Water Co.,	Pumping.
15. Williamsport Water Co.,	Williamsport and vicinity, Lycoming County,	Hagermans run, Mosquito creek and dug wells.	Gravity and pumping.

It is apparent from these definitions that the Legislature in passing the Act of 1907, used accurate and discriminating language in describing the waters over which your Commission should have jurisdiction for the purposes mentioned in the Act, and it is clear that your Commission by said Act was given jurisdiction over, first, all public rivers; second, all private rivers which are in fact navigable, although not declared public highways by Acts of Assembly, and, third, all private streams which have been declared public highways.

Applying these conclusions to the illustration mentioned in your communication you are advised that if the Casselman river is in fact navigable, within the definition given above, your Commission has jurisdiction to regulate all encroachments in or along the same.

Although not necessarily involved in your inquiry, it may be advisable to point out that in the opinion of this Department your Commission may have jurisdiction under certain conditions over purely private non-navigable streams. It is provided by the Act of 1907, not only that no obstructions shall be constructed in or along a public or navigable river or stream, heretofore declared a public highway, but also that no person, corporation or municipality shall, "in any manner change or diminish the course, current or cross section of any such river or stream" without the approval of the Commission.

If the construction of a dam or other obstruction in a purely private non-navigable stream would have the effect of changing or diminishing the course, current or cross section of any public or navigable river, heretofore declared a public highway, the Commission under the terms of said Act would, in the opinion of this Department, have jurisdiction to regulate the construction of such dam or other obstruction.

In reply to the contention of counsel for the corporations referred to in your letter, it may be observed that the construction herein placed upon the language of the Act in question is in harmony with the general rule of construction to the effect that a limiting clause or phrase following several expressions to which it might be applicable, is to be limited to the last antecedent.

Under this general rule of construction, the phrase "heretofore declared a public highway" should be limited to the last antecedent "stream."

Very truly yours,
J. E. B. CUNNINGHAM,
Deputy Attorney General.

TABLE NO. 3.

Water and Water Power Companies Incorporated in 1912 Which are in Operation.

Name.	Supplies.	Source of Supply.	System of Supply.
1. Central Broadheads Power Co.,	Stroud Township, Monroe Co.,	Brodheads Creek,	Water power.
2. Chinchilla Water Co.,	Chinchilla Village, Lackawanna County,	Drilled wells,	Pumping.
3. Cloe Water Co.,	Bell Township, Jefferson County,	Jackson run,	Gravity.
4. Cummings Water Co.,	Rayne Township, Indiana County,	Getty run,	Gravity.
5. East Donegal Township Water Co.,	Portion of Florin, Lancaster County,	Drilled well,	Pumping.
6. Houston Water Co.,	Houston Borough, Washington County,	Canonsburg, Wyoming County,	Pumping.
7. Ketner Water Co.,	Jones Township, Elk County,	Johnson run,	Gravity.
8. Kyle Water Co.,	Washington Township, Jefferson County,	Kyle run,	Gravity.
9. Lower Brodheads Power Co.,	Smithfield Township, Monroe County,	Brodheads creek,	Water power.
10. Manheim Township Water Co.,	Portion of Manheim Township, Lancaster Co.,	Lancaster water works,	Pumping.
11. Middle Brodheads Power Co.,	Stroudsburg, Monroe County,	Brodheads creek,	Water power.
12. South Strabane Water Co.,	South Strabane Township, Washington County,	Citizens' Water Co., Washington County,	Pumping.
13. Upper Brodheads Power Co.,	East Stroudsburg, Monroe County,	Brodheads creek,	Water power.
14. West Norton Water Co.,	Portion of West Norton Township, Montgomery County.	Norristown Insurance & Water Co.,	Pumping.
15. Williamsport Water Co.,	Williamsport and vicinity, Lycoming County,	Hagermans run, Mosquito creek and dug wells.	Gravity and pumping.

TABLE NO. 4.

Consolidations of Water and Water Power Companies Effected During the Year 1912.

Holding Company.		Constituent Companies.			
Name.	Incorporated For.	Name and Date of Incorporation.	Incorporated For.	Form of Consolidation.	Date of Consolidation.
Clarion River Power Co., ...	Portions of Clarion, Elk, Jefferson and Forest Counties.	Barnett Water Power Co., May 1, 1912.	Barnett Twp., Jefferson Co.,	Merger, ...	June 7, 1912.
		Clarion River Power Co., May 1, 1912.	Clarion Twp., Clarion Co.,..	Merger, ...	June 7, 1912.
		Farmington Water Power Co., May 1, 1912.	Farmington Twp., Clarion Co.	Merger, ...	June 7, 1912.
		Forest Water Power Co., May 1, 1912.	Barnett Twp., Forest Co.,..	Merger, ...	June 7, 1912.
		Heath Water Power Co., May 1, 1912.	Heath Twp., Jefferson Co.,..	Merger, ...	June 7, 1912.
		Highland Water Power Co., May 1, 1912.	Highland Twp., Clarion Co.,.	Merger, ...	June 7, 1912.
		Licking Water Power Co., May 1, 1912.	Licking Twp., Clarion Co.,..	Merger, ...	June 7, 1912.
		Mill Creek Water Power Co., May 1, 1912.	Mill Creek Twp., Clarion Co.	Merger, ...	June 7, 1912.
		Millstone Water Power Co., May 1, 1912.	Millstone Twp., Elk Co., ...	Merger, ...	June 7, 1912.
		Moroe Water Power Co., May 1, 1912.	Monroe Twp., Clarion Co.,..	Merger, ...	June 7, 1912.
		Paint Twp. Water Power Co., May 1, 1912.	Paint Twp., Clarion Co., ..	Merger, ...	June 7, 1912.
		Perry Water Power Co., May 1, 1912.	Perry Twp., Clarion Co., ..	Merger, ...	June 7, 1912.
		Richland Water Power Co., May 1, 1912.	Richland Twp., Clarion Co.,	Merger, ...	June 7, 1912.
Williamsport Water Co., ...	City of Williamsport, Lycoming County.	Citizens Water & Gas Co., May 24, 1865.	Portion of Williamsport, ...	Merger, ...	Jan. 12, 1912.
		Williamsport Water Co., April 18, 1853.	Portion of Williamsport, ...	Merger, ...	Jan. 12, 1912.
Monessen Water Co., ...	Township of Rostraver, Westmoreland County.	Donora Water Co., Oct. 3, 1900.	Donora Boro. and Carroll Twp., Washington Co.	Sale of property and franchises.	Aug. 22, 1912.
		Charleroi Water Co., June 17, 1890.	Charleroi Boro. and Fallowfield Twp., Washington Co.	Sale, ...	Aug. 22, 1912.

TABLE NO. 6.

Dams Which Have Been Constructed or Are Under Construction in Accordance with Plans Approved By the Water Supply Commission.

Owned By.	Location.	Type.	Length on crest.	Maximum height.
			Feet.	Feet.
1. Blue Mountain Consolidated Water Company,	Ross Common Creek, near Wind Gap,	Earthen,	450	26
2. Buffalo, Rochester and Pittsburgh R. R., Company,	Johnson Run, near Johnsonburg,	Earthen,	700	45
3. Evitts Creek Water Company,	Evitts Creek, near Cumberland, Md.,	Concrete,	235	85
4. Hosefeld, John,	Conodoguinet Creek, near Shippensburg,	Earth and concrete,	3,070	13
5. Johnstown Water Company,	Saltlick Run, at Mineral Point,	Hydraulic fill,	880	110
6. Lancaster city,	Conestoga Creek, at Lancaster,	Concrete,	180	6.8
7. Lock Haven city,	McElhattan Creek, at McElhattan,	Earthen,	400	28
8. Manufacturers Water Company,	Quemahoning Creek, at Holsopple,	Hydraulic fill,	1,200	100
9. Mt. Penn Suburban Water Company,	Tributary of Antietam Creek, at Mt. Penn,	Earthen,	350	16
10. North Strabane Water Company,	Speers Run, near Canonsburg,	Earthen,	600	30
11. Panther Valley Water Company,	Nesquehoning Creek, at Hauto,	Earthen,	1,600	31
12. Raystown Water Power Company,	Raystown Branch, Juniata River, near Huntingdon,	Earth and concrete,	800	35
13. Roaring Creek Water Company,	South Branch Roaring Creek, near Shamokin,	Earthen,	750	35
14. Tyrone Gas and Water Company,	Sink Run, near Tyrone,	Earthen,	818	50
15. York Water Company,	Codorus Creek, near York,	Earthen,	700	45

During 1912 thirty-two dams, heretofore constructed, have been examined, upon the request of individuals or municipalities, or upon application of the parties utilizing the structures, with the result that in a number of instances changes in the design, of greater or less extent, have been required.

Table No. 7 shows the number, type, dimensions, ownership, and location of dams examined during 1912.

TABLE NO. 7.

Dams Heretofore Constructed Which Have Been Examined By the Water Supply Commission.

Owned By.	Location.	Type.	Length on crest.	Maximum height.
			Feet.	Feet.
1. Abrams, N. J.,	Outlet of Westcolang Lake, Pike county,	Timber crib,	125	10
2. American Ice Company,	Perkiomen Creek, above Green Lane,	Timber crib,	200	12
3. American Ice Company,	Perkiomen Creek, above Green Lane,	Timber crib,	200	15
4. American Ice Company,	Perkiomen Creek, above Perkiomenville,	Timber crib,	250	12
5. American Ice Company,	Deep Creek, above Perkiomenville,	Timber crib,	400	15
6. American Ice Company,	Wright Creek, above White Haven,	Timber crib,	300	10
7. Bayless Manufacturing Company,	Freeman Run, above Austin,	Timber crib,	500	30
8. Brothers Valley Water Company,	Macdonaldton, Somerset county,	Earth and concrete,	420	16
9. Dauphin Consolidated Water Supply Company,	Stony Creek, at Dauphin,	Timber crib,	160	15
10. Dunbar Furnace Company,	Dunbar Creek, above Dunbar borough,	Concrete,	284	14
11. Dunbar Furnace Company,	Dunbar Creek, above Dunbar borough,	Concrete,	210	12
12. Dunbar Furnace Company,	Dunbar Creek, above Dunbar borough,	Concrete,	250	12
13. Eagles Mere Electric Light and Power Company,	Trout Run, near Eagles Mere,	Timber crib,	350	12
14. Frick, H. C., Coal Company,	Bute Run, at Juniata Mine,	Earthen,	400	22
15. Home Ice and Product Company,	Jacoby Creek, above Portland,	Earthen,	600	10
16. Lake Lodore Improvement Company,	Waymart Branch of Lackawaxen River, near Honesdale.	Concrete,	810	23
17. Lebanon city,	Hammer Creek, west branch, near Lebanon,	Earthen,	700	39
18. Lehighton Water Supply Company,	Long Run, near Lehighton,	Earth and concrete,	810	24
19. Lindsey Water Company,	Clover Run, near Punxatawney,	Timber crib and earth,	550	26
20. Luzerne Ochre Manufacturing Company,	Wright Creek, above White Haven,	Concrete and rock fill,	300	26
21. Mahanoy City Water Company,	Messers Run, near Mahanoy City,	Earthen,	950	21
22. Miller, K. S.,	Hagerman Run, above South Williamsport,	Earthen,	400	20
23. Mountain Spring Water and Ice Company,	Wright Creek, above White Haven,	Earthen,	600	44
24. Mathewson, S. C.,	Outlet of Sheridan Lake, Wyoming county,	Stone,	120	12
25. Pierce, Mr.,	Wilmer Run, at Berwindale,	Timber crib,	500	7
26. Rainey, W. J., Coal Company,	Dickerson Run, near Dawson,	Earthen,	350	20
27. Ricketts, Col. R. B.,	Pond Branch, Kitchen Creek, near Wilkes-Barre,	Timber, crib and earth,	150	16
28. Ricketts, Col. R. B.,	Pond Branch, Kitchen Creek, near Wilkes-Barre,	Timber crib,	300	20
29. Ricketts, Col. R. B.,	Lehigh Branch of Fishing Creek, near Wilkes-Barre,	Ambursen and earthen,	700	29
30. Summit Water Supply,	North Branch Conemaugh River, above Wilmore,	Masonry,	1,100	40
31. Tyrone Gas and Water Company,	Sink Run, near Tyrone,	Earthen,	640	36
32. Whitmore, D. C.,	Fall Brook, near Carbondale,	Stone,	125	10

DEFECTIVE DAMS.

An investigation has been made of failures or partial failures of dams which have occurred in this State, and descriptions of some of these structures and of their manner of failure is attached to this report. Most prominent, because of the great loss of life and property which resulted, are the Johnstown and Austin catastrophies. A study of these failures may aid in preventing the repetition of such disasters. Wherever reliable information can be obtained, the Commission is also collecting and compiling data concerning failures of dams throughout the world, but these data, although of great interest, are too voluminous to include in the report.

Although this record of the injuries to important dams in Pennsylvania, extending over some twenty-five years, warrants investigation of all existing structures and careful scrutiny of those being built, it should be remembered that the number of dams which have proved insecure is a small percentage of those which have been constructed within the Commonwealth. The Commission also recognizes the existence of some structures on our streams which are open to suspicion and may cause anxiety, but is using its best efforts to eliminate such structures.

INVESTIGATION OF WATER RESOURCES.

The Act of May 4th, 1905, organizing the Commission, charged it with the duty of procuring all data and facts necessary to advise it thoroughly of the situation of the water supply of the State. This the Commission has done, in so far as the resources at its command permitted, and in its annual reports has placed the same at the disposal of the public.

During 1908-09 an examination was made of the active water works in the State, including those owned and operated by municipalities, corporations and private individuals, involving 755 separate systems. The 1751 existing charters of water companies were also reviewed, and the status of each investigated to determine whether or not advantage had been taken of the charter rights. The results of this extended study were published in the 1909 report.

A system of stream discharge measurements, to determine the daily flow of streams, undertaken by the Commission in 1907, has been maintained and enlarged. Some of the large rivers and a few smaller streams had been previously gaged by the United States Government or by local authorities. In the 1911 report of the Commission all reliable data of stream discharge were collected, revised and published, to present in one volume complete records of reliable stream flows in Pennsylvania, which is believed to be the most extensive and complete published by a State. The 1912 records appear in Appendix B to this report.

An investigation was made of the navigation on Pennsylvania streams, including the early use before improvement; and a thorough collection of data concerning the State and Corporate Canal Companies and their systems of navigation, as well as the extent of the use of the rivers for this purpose to-day, has been made.

A census has been made of the developed water powers, and also an investigation of outstanding water power charters. Record was obtained of over 2,000 grist, flour and saw mills operated by water power. Their total capacity is considerable, but most of them either cease operating in dry seasons or use auxiliary power, and numerous others are in poor physical condition; the total number in use is decreasing rapidly.

The largest developments of water power in Pennsylvania are on the Susquehanna watershed, where a total of 112,700 horse power, rated capacity, is installed in four plants, 106,000 horse power being on the main river below Harrisburg, where two plants have installed 86,000 and 20,000 horse power, respectively. The remaining 6,700 horse power is in two plants of 4,000 and 2,700 horse power capacity, respectively, on the Frankstown and Raystown branches of the Juniata river, in the vicinity of Huntingdon. The available power of the Lehigh river has probably been more fully utilized than that of other streams, although it is far from complete. Along this stream from Mauch Chunk to Easton the fall between the Lehigh Coal and Navigation Company canal and the Lehigh river has been developed through the installation of a total of over 5,000 horse power of wheels. Similarly, on the Schuylkill river, the fall between the Schuylkill Navigation Company canal and the river is utilized by manufactories and hydro-electric plants, between Reading and Philadelphia, to the extent of 3,500 installed horse power.

In the western part of the State there is practically no hydro-electric development on the Allegheny and Monongahela watersheds, but on the lower five miles of the Beaver river manufacturing and hydro-electric plants have installed 2,800 horse power of turbines.

Those mentioned are all of the important water power developments in the State. Many are projected, however, and during the last two years charters have been granted covering the development of over 175,000 horse power by five extensive projects. The proposed plants differ from those now operating in an important respect,—in that the present hydro-electric plants are all operating on unregulated rivers, and, therefore, have a greatly fluctuating output; while those recently incorporated, with one exception, involve the practically complete storage and regulation of the streams to be used and thorough utilization of the power thereof, the output being mostly primary power. These developments involve high dams, large storage reservoirs and equable flow throughout the year, which would benefit the dry weather flow of the rivers to which the developed streams are tributary, reduce the floods thereon, and improve navigation.

The undeveloped water power resources should be completely investigated, and through its stream gaging system the Commission has taken an important step to advance this study. The location and examination of storage reservoirs is a factor of moment in considering this phase of the utilization of the streams, and it will require generous appropriations to investigate this question thoroughly. At the same time, the problem of stream regulation for increasing dry weather flow, navigation and flood reduction should be studied.

It is to be regretted that a systematic investigation of this sort was not made before our streams became so generally followed by railroads, and bordered by settlements, for these may increase the cost of the development of valuable water powers beyond economic limits. Under the Act of May 28th, 1907, the Commission has been able to reserve at least one valuable water power stream for such use, by determining the point at which a railroad should cross it, so as not to interfere with the ultimate development of the stream. It is hardly reasonable to hold up railroad development because it has not been determined whether or not water power, navigation or storage should be given preference on a certain stream; but if a systematic study had been made and the best utilization of the important streams already determined, such questions could be more readily settled. The State should pass upon the occupancy of a stream valley by a railroad before its charter is granted or work commenced. A comprehensive plan of development and utilization of the water resources should be built upon the foundation laid by the Commission, which should be done speedily, so as not to retard legitimate industrial development, whether such utilization and the regulation of the flow of streams is to be undertaken by State or private enterprise.

The two largest recently approved water power projects were granted subject to certain restrictions and limitations, which it was considered necessary to attach to the charters owing to the absence of legislation, but all subsequent applications for water power charters have been held under advisement, pending the passage of laws more fully covering the subject. The changes which have been taking place in hydro-electrical development have not been kept pace with in legislation, and the session of 1913 should provide the necessary laws giving proper jurisdiction to the State over such corporations. Following are the conditions of approval referred to.

CONDITIONS IN RE APPROVAL OF MERGER OF CLARION RIVER POWER COMPANY.

Approved May 28th, 1912, subject to the following conditions:

"First. That the corporation formed by the above proceedings in merger and consolidation shall not construct, erect, or build any dam, wall, wing-wall, wharf, pier, embankment, abutment, projection, or other obstruction in or along any river or stream, nor in any manner change or diminish the course, current or cross section of any river or stream, unless and until the company hereinabove named shall have submitted to the Water Supply Commission of Pennsylvania complete maps, plans, profiles and specifications and such other information and data as the said Water Supply Commission of Pennsylvania may deem necessary relating to any proposed dam, wall, wing-wall, wharf, pier, embankment, abutment, projection or other obstruction, and a majority of the members of the Water Supply Commission of Pennsylvania shall have approved the same:

"Second. That on or before May 1st, 1913, there shall be presented to The Water Supply Commission of Pennsylvania the following data, determined by actual physical inspection, test and survey:

> "(a) An accurate map of the area flooded by each dam, with contours sufficient to calculate the quantity of water impounded at various depths; also revised data concerning rainfall, run-off, available storage, and the effects upon them by drought or freshet conditions. Also the extent to which the reservoirs formed can be used to ameliorate floods in the Clarion and Allegheny rivers;
>
> "(b) Design of each dam with spillways, drains, and other appurtenances, showing its proportions, with stress diagrams, demonstrating the stability and adaptability to the site selected;
>
> "(c) Definite information, obtained by suitable investigation, concerning the character of foundation upon which the dam will rest, and of the geological structure of the side slopes of the valley;
>
> "(d) Method proposed for utilizing the water power, in sufficient detail to advise The Water Supply Commission of Pennsylvania of the location and character of power station, with its equipment, and of the distribution of the power developed.

"The data as to foundation, side slopes, proportion of the dam, spillway, power station, and other appurtenances, to be accompanied by reports from at least two engineers of recognized standing, and familiar with similar structures, as to their stability, sufficiency, and adaptability for the purpose and location indicated.

"Third. That the requirements of the Corps of Engineers, United States Army, in charge of the Allegheny river, as to the minimum stream discharge, must be embodied in any plan for using the water stored, as well as the rights of lower riparian owners to have available at all times at least the minimum stream flow, as determined by The Water Supply Commission of Pennsylvania, must be protected.

"Fourth. That the construction of the dam must be under the personal supervision of an engineer skilled in this branch of his profession, who must be constantly represented by competent inspectors to issue that the construction is carried out in strict conformity with the plans and specifications which may be approved by the Commission; this to be entirely independent of such inspection and oversight as the Commission elects to give to the work.

"Fifth. That the company hereinabove named must satisfy the Commission, by written testimony satisfactory to the Commission, on or before November 1st, 1913, of its ability to carry the construction forward promptly and continously, a requirement which is demanded by the influence which the proposed improvement will have upon the property values affected.

"Sixth. That the operation of reservoirs, in so far as the control of floods and the maintenance of low water flow is concerned, shall be subject to the direction and jurisdiction of the Water Supply Commission of Pennsylvania.

"Seventh. That in disposing of the power produced by the said company, the preference shall be given to individuals, corporations and committees within the State of Pennsylvania, upon equal terms and conditions of payment for the same;

"Eighth. That this charter shall not go into effect until the company shall, pursuant to corporate action, accept the same by its proper officials, covenanting at the same time that a failure to comply with the conditions herein named shall work a revocation of its privileges by said charter granted; said acceptance shall be filed in the office of the Water Supply Commission of Pennsylvania, and a copy thereof in the office of the Secretary of the Commonwealth, within thirty (30) days after the issuance of Letters Patent by the Governor of the Commonwealth."

PYMATUNING SWAMP INVESTIGATION.

An important step in the development of our water resources was taken during the year in the completion of an examination and report by the Engineering Corps of the Commission upon the feasibility of constructing a storage reservoir in Pymatuning Swamp, Crawford county. This swamp, covering over 10,000 acres, lies at the headwaters of the Shenango river, which passes through Greenville, Sharon, Farrell, and New Castle, thence into the Beaver river and later into the Ohio river. The dry weather flow of this stream as the report shows is insufficient for the industrial and domestic uses required of it, while on these streams the value of water powers is decreasing; sanitary conditions are bad, and frequent damage is caused by floods. The report demonstrates that the construction of a reservoir in this swamp, to store sixty-one thousand million gallons, is feasible and will give an ample water supply the year around, improve the water power and sanitary conditions in the lower valley, and reduce flood damage. The full report of the Commission on this project, which was made as a result of a special appropriation by the Legislature of 1911, is attached to this report as Appendix A.

CHAPTER II.

FAILURES AND PARTIAL FAILURES OF DAMS IN PENNSYLVANIA.

Examinations of dams which have failed wholly or in part, and study of reports and descriptions of such structures, are fertile sources from which to obtain practical knowledge concerning methods of designing and building them, and the Commission has made it a point to obtain such information whenever possible.

Exceedingly few of the large dams in Pennsylvania have failed; but three great catastrophies have unfortunately resulted from this cause,—at Johnstown, in 1889; at Oakford Park, in 1903, and at Austin, in 1911, resulting in the loss of 2,142, 23 and 77 lives respectively. The majority of injured dams have been small, unimportant structures, causing little injury. When large and important dams have failed investigation has proved, unfortunately, that sufficient caution and thoroughness have not been exercised in the design, construction and maintenance.

Table No. 8 gives 28 of the larger dams in Pennsylvania which have suffered total or partial failure. Some of these have resulted in the absolute demolition of the structure, and complete and rapid emptying of the reservoir, requiring entire rebuilding or abandonment. Others affected only portions of the dams, and did not result in the entire loss of stored water. These 28 dams have failed or have been injured within the last twenty-five years, and there have doubtless been numerous others of which record has not been obtained. Four of them have resulted directly in the loss of life, and many have caused property loss only in so far as the structure itself is concerned.

TABLE NO. 8.

List of Failures or Partial Failures of Dams in Pennsylvania.

Name.	Location.	Type.	Cause of Failure or Partial Failure.
Lake Leigh Dam,	Kitchen Creek, Luzerne County,	Ambursen,	Faulty foundation.
Austin Dam,	Freemans Run, Potter County,	Concrete-gravity section,	Faulty foundation.
Austin Dam,	Freemans Run, Potter County,	Timber crib,	Faulty construction.
Macdonaldton Dam,	Buffalo Creek, Somerset County,	Concrete-gravity section,	Faulty foundation.
Kittanning Point Dam,	Burgoon Run, Blair County,	Earthen,	Insufficient spillway capacity.
Mahanoy City Water Co. Dam,	Coal Run, Schuylkill County,	Earthen,	Faulty construction.
South Fork Dam,	South Fork Conemaugh River, Cambria County,	Earthen,	Insufficient spillway capacity.
Oakford Park Dam,	Brush Creek, Westmoreland County,	Earthen,	Insufficient spillway capacity.
Fort Pitt Dam,	Bull Run, Westmoreland County,	Earthen,	Insufficient spillway capacity.
Green Lick Run Dam,	Green Lick Run, Fayette County,	Earthen,	Faulty foundation.
Hosfeld Dam,	Connodoguinet Creek, Franklin County,	Concrete-gravity section,	Faulty design and construction.
Clover Run Dam,	Clover Run, Jefferson County,	Timber crib,	Insufficient spillway capacity.
North Strabane Water Co. Dam,	Little Chartiers Creek, Washington County,	Timber crib,	Insufficient spillway capacity.
Dunbar Furnace Co. Dams,	Dunbar Creek, Fayette County,	Concrete,	Faulty design and construction.
Brookville Water Co. Dam,	North Fork Creek, Jefferson County,	Earthen,	Insufficient spillway capacity.
Lebanon City Dam No. 2,	East Branch Hammer Creek, Lebanon County,	Earthen,	Faulty design and construction.
Boydstown Dam,	Thorne Run, Butler County,	Earthen,	Insufficient spillway capacity.
Connellsville Water Co. Dam,	Breakneck Run, Fayette County,	Earthen,	Insufficient spillway capacity.
Latrobe Water Co. Dam,	Loyalhanna Creek, Westmoreland County,	Timber crib,	Faulty design and construction.
Ketner Dam,	Johnson Run, Elk County,	Earthen,	Faulty construction.
Tyrone Gas and Water Co. Dam,	Sink Run, Blair County,	Earthen,	Faulty construction.
Tumbling Run Dam,	Tumbling Run, Schuylkill County,	Earthen,	Insufficient spillway capacity.
Kauffman Run Dam,	Kauffman Run, Schuylkill County,	Earthen,	Faulty construction.
Birdsboro Water Co. Dam,	Indian Run, Berks County,	Earthen,	Percolation along pipe line.
Irondale Dam,	Fishing Creek, Columbia County,	Timber crib,	Faulty construction.
New Brighton Dam,	Beaver River, Beaver County,	Timber crib,	Faulty construction.
Colonial No. 4 Dam,	Calvin Run, Fayette County,	Concrete-gravity section,	Faulty construction.
Salt Lick Creek Dam,	Salt Lick Creek, Susquehanna County,	Stone and earth,	Insufficient spillway capacity.

In the following pages descriptions of certain of the failures or partial failures listed in the above table are given. Unfortunately, full details could not be obtained concerning all of these, but an attempt is being made to secure information regarding the remainder.

An analysis of Table No. 8 indicates that 16 of the 28 dams were earthen structures, 6 masonry and 6 timber crib. The following Table No. 9 indicates the cause of the failures or injuries in each of the three types of dams.

TABLE NO. 9.

Cause of Failure or Partial Failure of Dams in Pennsylvania.

Type.	Cause of Failure or Damage.				
	Faulty foundation.	Faulty construction.	Faulty design and construction.	Insufficient spillway capacity.	Percolation along pipe line.
Earthen,	1	4	1	9	1
Masonry,	3	1	2	0	0
Timber crib,	0	3	1	2	0
Total,	4	8	4	11	1

It will be observed that the principal cause is insufficient spillway capacity, and that this occurs in earthen structures, resulting in overtopping the embankment and its subsequent erosion or destruction. In one case of this sort the presence of a concrete core-wall within the embankment apparently saved the structure from being carried entirely away.

The second largest number is from improper construction, which means that if these dams had been built with care and thoroughness, with the same dimensions, they probably would have been stable. In the case of the four earthen dams which failed or were damaged from this cause, two were not built of material suitable for the purpose, while the other two failed during construction; in one instance because suitable provision was not made for taking care of the flood flow in the stream and in the other because the core-wall was built almost to its full height in advance of the embankment. In the case of the single masonry failure the concrete was poor, while the timber dams were either not suitably filled with stone or had been allowed to decay.

The four dams which failed from faulty design and construction are unfortunately typical of many such structures in which the layman failed to realize the necessity and advantage of securing engineering advice, and it is remarkable that so many of such structures have withstood the test. It can be claimed that the dams having insufficient spillways were faulty in design, but the distinction has been made on account of the large percentage of failure from this cause.

Four of the dams had faulty foundations. Three of these were masonry structures, and one was earthen. It is needless to say that a good foundation is absolutely essential for stability and efficiency in a dam, and that the importance of securing such foundation increases with the height of the structure.

One dam proved unsuccessful because of percolation along the pipe lines through the embankment, a condition which may jeopardize others.

There are many dams, possibly a thousand or more, of various types in Pennsylvania, and of these between three and four hundred store considerable volumes of water and whose failures might cause disaster. As our State becomes more densely populated it becomes more necessary to prevent insecure dams from being built, as the liability of damage from a dam failure increases. Few have failed, and in these cases the cause is usually quite evident. Many of the smaller structures were designed and built by men inexperienced in engineering; and it is believed that, by insisting on proper engineering talent in the designing of such structures, the State may, by a critical review of the plans and specifications and by careful and systematic inspection during construction, insure a smaller ratio of insecure dams. In the case of earth filled dams, as above stated, the spillway capacity is a vital point, and it is hardly to be expected that a man not familiar with the variability of stream flow will be able to properly estimate the dimensions required for safety. It has been found that in the plans which have been placed before the Commission, in connection with applications for construction of new dams, in few cases has the spillway capacity been sufficient, according to the standards of the Commission.

At one time, the predominating type of dam in Pennsylvania was the timber crib structure, stone or earthen filled, used for logging and ice pond purposes, and for improving navigation. Many of them have been in existence for scores of years, but not being properly maintained and kept in repair their deterioration has been rapid, and numerous failures have occurred.

Another feature deserving attention is the existence of abandoned dams. Such structures are a menace and should be removed. Of this class are dams which have been built for logging or ice ponds, and their usefulness has expired by reason of discontinuance of the operations which made their construction necessary. The attention of the owners of such dams is directed to the potential danger in these structures.

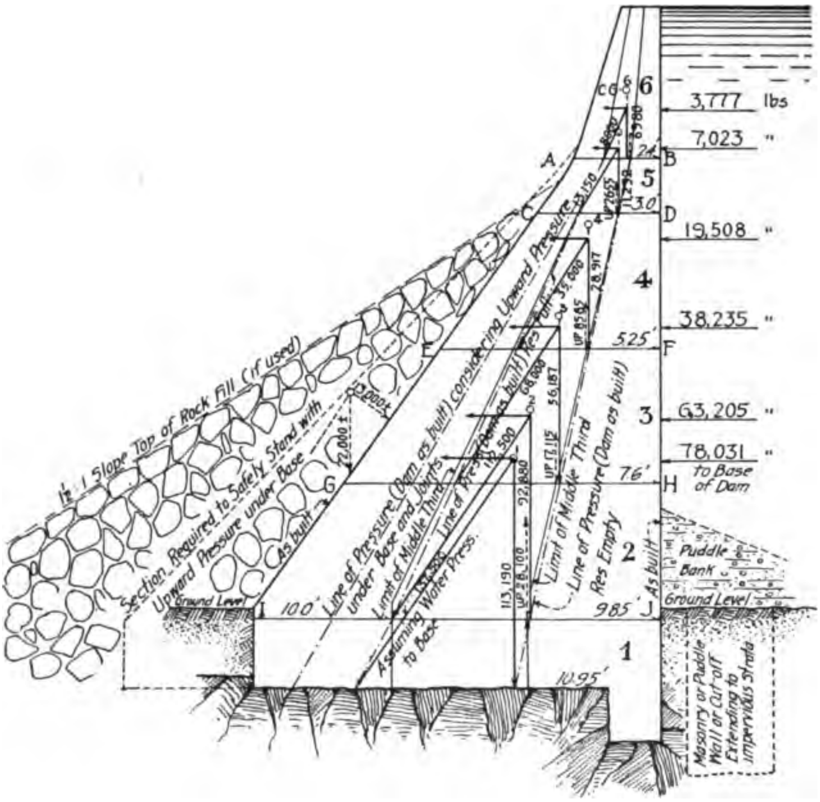
AUSTIN DAM.

The Austin concrete dam was constructed in 1909 on Freemans Run, near Austin, Potter County, which stream has been used since 1902 for water supply by the Bayless Pulp and Paper Company, of Binghamton, New York, at its mill on the creek about one-half mile above the town. The first dam built by this company was a low earthen structure, with masonry core-wall, one mile above the mill, which provided a reservoir of small capacity, and soon failed to meet the increased water consumption in the plant. A reservoir of larger capacity was decided upon, and an engineer engaged to design and supervise the construction of a concrete dam of sufficient dimensions to form a reservoir of 200,000,000 gallons capacity. Construction work on a percentage basis was begun in May and completed in November, 1909. The concrete dam was about 800 feet below the earthen structure, nearly three-quarters of a mile above the paper mill, and one and one-quarter miles above the center of the village. The reservoir, as constructed, had a capacity of appromimately 350,000,000 gallons, the pool being 3,300 feet long and 500 feet wide, and the area of the water surface about 35 acres. On September 30th, 1911, this dam suffered complete failure, resulting in the loss of 77 lives.

Freemans Run drains an area of 34 square miles in the southwestern part of Potter County, joining the first fork of Sinnemahoning Creek at Costello. At Austin, three miles above its mouth, the stream forks, the main branch draining an area of 15 square miles, and the west branch an area of 12 square miles. The Bayless dam is on the main stream, the drainage area above consisting of 14 square miles of mountainous land, almost entirely denuded of timber. The runoff from this territory is rapid and the stream is flashy in character, the yearly rainfall over this district averaging about 40 inches.

Below the dam the valley follows a straight line to Austin, descending some 15 feet in the 1¼ miles, and being from 600 to 1,000 feet in width, with steep and barren hillsides. Below Austin the valley becomes narrower, and the side-hills are steeper and partly timbered. This portion of the valley, and that of the West Branch, is followed by the Buffalo & Susquehanna Railroad, while the main stream above Austin is followed only by a public highway. The borough of Austin had a population, before the flood of September 30th, 1911, of approximately 3,000, while the population of the town of Costello was about 500. The houses in Austin followed the main stream above and below the forks and the West Branch of Freemans Run, with a majority of the houses and mills in the flat along the main stream.

The new dam was constructed of boulder concrete, approximately 550 feet long on top and of a maximum height of practically 50 feet. The width of the crest was 30 inches and the maximum width on


1½ : 1 Slope Top of Rock Fill (if used)
Section Required to Safely Stand with Upward Pressure under Base
As built
Ground Level
A
B
C
D
E
F
G
H
J
1
2
3
4
5
6
CG
3,777 lbs
7,023 "
19,508 "
38,235 "
63,205 "
78,031 " to Base of Dam
2.4'
3.0'
5.25'
7.6'
10.0'
9.85'
10.95'
12,000±
12,000±
Line of Pressure (Dam as built) considering Upward Pressure under Base and Joints
Limit of Middle Third
Line of Pressure (Dam as built) Res Full
Assuming Water Press. to Base
Limit of Middle Third
Line of Pressure (Dam as built) Res Empty
As built
Puddle Bank
Ground Level
Masonry or Puddle Wall or Cut-off Extending to impervious Strata
33,150
35,000
28,917
68,000
56,187
92,880
113,190
6,980
Up 8,585
Up 17,115
Up 28,100
Up 2,655

STUDIES FOR REINFORCING MASONRY DAM AT AUSTIN, PA.
E. WEGMANN, CONSULTING ENGINEER

Engineering News, Vol. 66. No. 14

the base 30 feet, the upstream face being vertical, with a rolled embankment placed against it to within 30 feet of the crest. The spillway, which was in the center, was 40 feet long and 30 inches deep.

The following description of the construction and the accompanying Figure 2 are taken from the Engineering News of March 17th, *1910:*

"The entire valley is underlain with sandstone rock in horizontal layers running from 8 inches to 3 feet thick. Between these layers beds of shale and disintegrated sandstone were located, but there were very few vertical cracks to be observed in the bed of rock. Upon the surface of the rock there was from 5 to 8 feet of earth and compacted gravel deposited from the washings of the side-hills. This was so well cemented together that it was removed with utmost difficulty, and but little water filtered through it into the foundation trench during construction.

"In preparing the foundation all loose rock was removed and the concrete only started after a solid stratum of at least 2 feet thick was encountered. The surface of the rock was well washed and grouted. A cut-off wall 4 feet thick and 4 feet deep was built, as shown upon plan, Fig. 2, and in every case this cut-off wall was carried down to good rock. In order to reinforce the dam twisted steel rods 1¼ inches in diameter and 25 feet long were built into the wall vertically 5 feet inside of the upstream face. Holes were drilled into the foundation rock from 5 to 8 feet deep, and 2.66 feet between centers, and the steel rods with expansion bolt-heads were placed into these holes, which were then grouted.

"Upon each side of the spillway a pilaster was built which was reinforced by ½-inch steel rods to prevent cracking. The top 12 feet of the dam was reinforced with ½-inch steel rods spaced 2 feet vertically and 4 feet horizontally to prevent cracking. Against the upstream face of the dam an earthen embankment was laid at a slope of 3 to 1 and reached to within 27 feet of the normal water level at the upstream face of the dam. This embankment was composed of disintegrated shale, clay and some loam, free from large stones, and was carefully compacted by grooved rollers in 6 to 8 inch layers, the work being carefully and well done.

"The dam was composed of cyclopean concrete, with large quarry stone, from ½ to 2 cu. yd. size, embedded firmly in wet concrete. These stones were placed so as to break joints, both as headers and stretchers, and surrounded with not less than 6 inches of concrete, generally much more. In every case the concrete was built in sections, and the steps dove-tailed both horizontally and vertically. In building into the side-hills great care was used in getting down to good firm rock foundation before any concrete was laid.

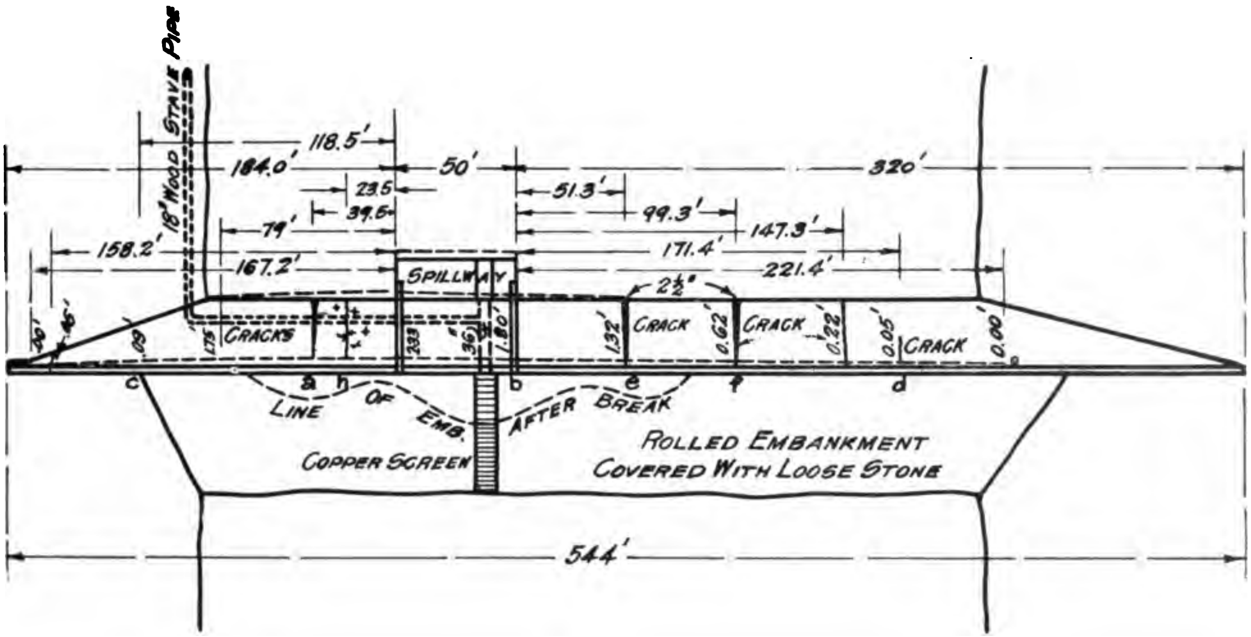
"The material for building the dam was secured from quarries opened at either end of the dam, where duplicate crushers and mixing plants were located. The sand was secured by crushing the standstones with rolls and screening through sand pans. The composition of the concrete was one part Portland cement, three parts of sand and six parts of broken stone. Each shipment of cement, as received, was tested upon the works by the resident engineer, who also made numerous tests to ascertain the difference between the tensile strength when using washed bar stand and the sand secured from crushing stone. In every case the mixture containing the sand from the crushed stone gave the greater tensile strength.

"The concrete was handled in two ways. At the two ends it was run down chutes upon the dam, and there shoveled into place. In the middle of the valley the cableway stretched across the valley carried the concrete in buckets to the wall, where it was shoveled into place. In every case it was well turned over and mixed after leaving the mechanical mixer."

The dam contained 16,000 cu. yds. of concrete and 6,400 cu. yds. of embankment, and is said to have cost about $75,000.

An account of its condition between the time at which it was completed December 1st, 1909, and its collapse, on September 30th, 1911, together with a description of its partial failure, and drawing illustrative thereof, is quoted from an article by Frank P. McKibben, Professor of Civil Engineering, Lehigh University, in the Journal of the Engineers' Society of Pennsylvania, January, 1912:

"In December, 1909, after the dam was completed, and before there was any water in the reservoir, two vertical cracks appeared, one 51.3 feet to the west of the spillway and the other 39.5 feet to the east thereof. These cracks were about one-sixteenth inch wide and extended from the ground to the crest, and were due to contraction. In January, 1910, the reservoir filled so that on January 21st, water was flowing over the spillway. On January 22nd there was a landslide on the east hill on the downstream side of the dam and water was passing from under this slide. Furthermore, water passed under the structure and came up through the ground on the downstream side several feet below the dam. The next day that portion of the structure between "a" and "b," Fig. 3, slid downstream 18 inches at the bottom and 31 inches at the top, and according to Engineering News this sliding was a maximum at a joint 'h' and running out to nothing at 'c' and 'd.' The crack at 'a' opened 4 inches, at 'h' 4½ inches and at 'e' and 'f' 2½ inches at the bottom on the downstream face but pinches nearly together on the upstream face.' The reservoir was then emptied and the water pressure on the upstream face thus released by removing, with dynamite, an upper portion of the dam at the west end, a large "V"



PLAN OF BAYLESS PULP & PAPER COMPANY'S DAM

Note:- Dotted Lines Indicate Position After Breaking

Reproduced From Eng. News Mar 17th 1910

shaped section nearly 15 feet deep just east of the spillway, and also a wooden cap from the downstream end of the clean-out pipe. After the reservoir was emptied it was seen that the rolled embankment which had been originally placed against the upstream face, as shown in Fig. 3, had been washed out for a distance of about 100 feet on each side of the intake chamber and that each side wall of this chamber had a crack about 18 inches wide. These side walls of the chamber were perpendicular to the dam's upstream face, so that a motion of 18 inches at the bottom of the dam caused a corresponding crack of 18 inches in the walls and a portion of each wall remained attached to and moved with the dam when it slid.

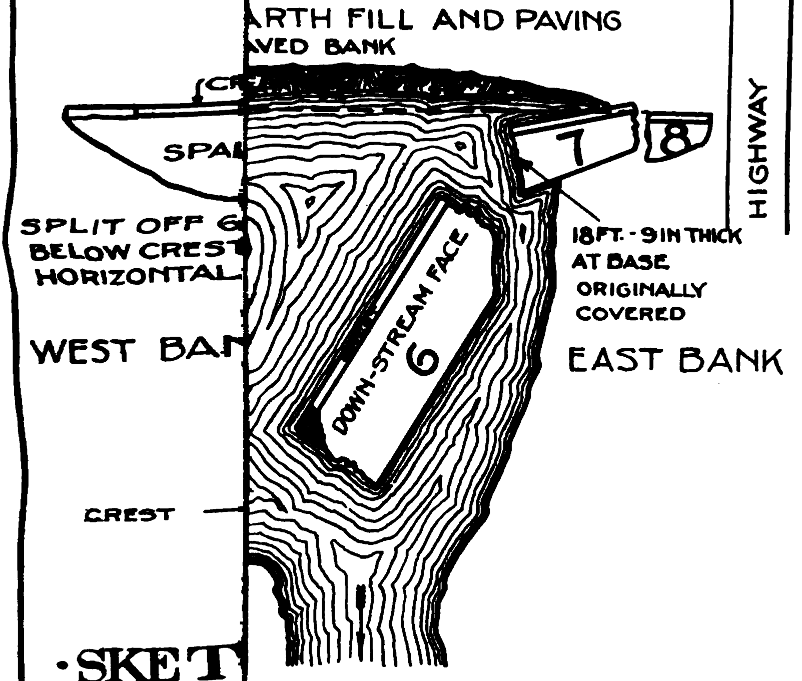
"According to the Engineering News of March 17th, 1910, excavations made above the dam showed that the rock foundation together with the dam had slid forward, due to water getting under the foundation, softening up a stratum of clay or shale lying between two layers of rock, and permitting one layer of rock to slip forward about 18 inches upon the lower layer. After the structure had moved and cracked, as above described, nothing was done to strengthen it, but water was again allowed to collect behind it so that in March, 1910, there was a depth of 36 feet of water in the reservoir, and later in the same month the water rose to within two feet of the overflow and two streams were passing under the dam, appearing about 10 feet below the toe, and another stream was passing around the east end of the dam. Evidently, then, the clean-out pipe was closed so that the reservoir had considerable water in it two months after the first failure."

Following this partial failure plans were prepared for strengthening the structure, and were submitted to the Bayless Company in February, 1910, but nothing was done toward carrying out the recommendations. The proposed method of repair and strengthening is shown in Fig. 2, and includes a rock load placed at a slope of 1½:1 against the downstream face of the dam and a "masonry or puddle wall or cut-off extending to impervious stratum" a short distance above the upstream face. In September, 1911, one of the holes blown out of the dam in 1910 was refilled, and the other was in process of refilling when the reservoir overflowed and the dam failed.

Heavy rains caused the rapid accumulation of water in the reservoir, and on the afternoon of September 30th, the spillway level was reached and the dam leaked badly at numerous points. About 2.30 P. M., when two inches of water flowed over the crest, a portion of the concrete near the west end burst forward and was immediately followed by a complete demolition of the structure, proceeding in sequence from the west to the east end. The water, released almost simultaneously across the dam, picked up thousands of cords of pulp wood stored between the dam and the paper mill, descending upon the town, caused the loss of 77 lives, carried away buildings, streets, trees and all else in its path, in Austin, and destroyed numerous buildings in Costello.

The structure broke into eight major pieces, numbered consecutively from 1 to 8 in Figure 4, beginning on the west side. No. 1 is the west cut-off wall 30 inches wide on top, which is still in place for about 135 feet. No. 2 is a large block of the rollway, 20 feet long, immediately adjoining the cut-off wall, which broke off about 35 feet below the crest, where its width was 18 feet, pulling away from four 1¼ inch twisted steel bars, and was deposited with its base facing upstream about 100 feet below the dam. The third block was torn from its foundation, leaving a portion of the upstream side thereof, in place above water, and was deposited some 40 to 50 feet below its original position. The 4th piece, 100 feet long, containing the foundation and rollway section, moved downstream so that at its central point it is 21 feet off line, the west end being a little upstream of the east end. The next, or 5th piece, 130 feet long, also moved bodily downstream, its west end being approximately 25 feet off line, and the east end about 40 feet, the opening between the 4th and 5th pieces being about 8 feet at the top and 3 feet at the bottom. This piece includes the spillway. A large crack started at the east end of the spillway, and ran down the face of the dam in an irregular line to the water line, where it is several inches wide. The 6th piece, about 80 feet long, likewise moved downstream so that its west end is about 60 feet off line, and its east end about 25 feet. Between the 5th and 6th pieces is a large gap about 40 feet wide, in which lies a block of concrete which appears to be that which was used in refilling the gap blown out by dynamite as above mentioned. The 7th piece, 40 feet long, is about 5 feet off line at the west end and almost on line at the east end. The 8th piece is the east cut-off wall and it is in place, extending 20 feet out from the bank, No. 7 having been broken from it at this point where the retaining wall section changes to the dam section. The downstream side of the top of the 7th section is almost touching the upstream face of the top of the 8th section. The sections which moved are inclined slightly upstream.

The exact cause of the failure of the Austin concrete dam has not yet been definitely determined, and cannot be until the foundation is exposed for inspection. It appears to be the almost universal opinion, however, that the dam failed by sliding, either on a plane between the bottom of the concrete and the underlying strata, or along a joint in the seamy rock foundation. The opinion also is practically universal that there was upward water pressure on the


ARTH FILL AND PAVING
AVED BANK
(CR
SPA
7
8
HIGHWAY
SPLIT OFF 6
BELOW CREST
HORIZONTAL
18 FT. - 9 IN THICK
AT BASE
ORIGINALLY
COVERED
WEST BA
EAST BANK
DOWN-STREAM FACE
6
CREST

·SKET

base, and along the horizontal construction joints in the concrete masonry. The following are opinions expressed by prominent engineers, who have visited the ruined structure:—

> Alfred D. Flinn—Coroner's Inquest, Nov. 2nd, 1911, at Coudersport, Pa.,—"Improper foundations, incorrect design, faulty construction, and insufficient supervision were the causes of the failure. The dam failed by sliding downstream, and breaking into several large pieces and innumerable small fragments."
>
> John R. Freeman—Engineering News, October 19th, 1911—"Subject to further information, it appeared to me that in this seamy character of the bed rock of these Austin dams, and in the lack of proper precautions to meet this condition, is found the immediate cause of both failures."
>
> Frank P. McKibben—Journal of the Engineers' Society of Pennsylvania, January, 1912—"Failed by sliding, first on fragment 'G,' where all concrete slipped on the underlying strata, and probably immediately thereafter at the horizontal construction joint under fragment 'H;' and then fragments 'F,' 'E,' 'D,' 'C,' and 'B' slid forward on the underlying strata."
>
> Walter H. Sawyer—Engineering Record, Nov. 4th, 1911—"Failed by sliding along horizontal construction joints, filled with laitance of but little strength. Primary cause of failure was poor inspection and construction." Also, in Journal of the Association of Engineering Societies for June, 1912—"I believe now that parts of the dam slid along the upper surface of the foundation rock, other parts on a plane between the upper layer of the foundation rock and the main body of the rock itself; but the larger part slid on joints in the concrete, which were lubricated by the laitance left during construction."
>
> E. Wegmann—Engineering News, October 12th, 1911—"I think that all engineers who have examined the ruptured dam will agree that the failure was due to sliding."

The cross section of the dam is shown in Figure 2 and on it are indicated the lines of pressure for the dam as built, for reservoir empty; for reservoir full, with no allowance for upward water pressure under the base or in the body of the dam; and for reservoir full with an assumed upward water pressure under the base and joints of the dam equal to two-thirds of the hydrostatic pressure, due to the head at the upstream face, and decreasing uniformly to zero at the downstream face. The weight of the masonry was assumed to be 135.4 lbs. per cu. ft., which is probably somewhat low, although on the side of safety. So far as can be learned, no definite determination has yet been made of the weight of the cyclopean concrete. At the instigation of Mr. Walter H. Sawyer tests for weight and specific gravity were made of samples of the concrete and laitance from the dam by Mr. Herbert L. Sherman, of Boston, with the following results:

	Specific gravity.	Weight. Lbs. per cu. ft.
Larger dark colored concrete,	2.46	153.75
Smaller light colored concrete,	2.42	151.25
Large piece laitance,	1.72	107.50
Small piece laitance No. 1,	1.78	111.25
Small piece laitance No. 2,	1.68	105.00

Calculations were made of the stability of the dam, using 150 pounds per cubic foot as the weight of the masonry, which is in approximate accordance with the results of the tests quoted above. Joints were assumed to be 11, 22, 33 and 44 feet below the top of the dam, and at the base, as shown on Figure 5.

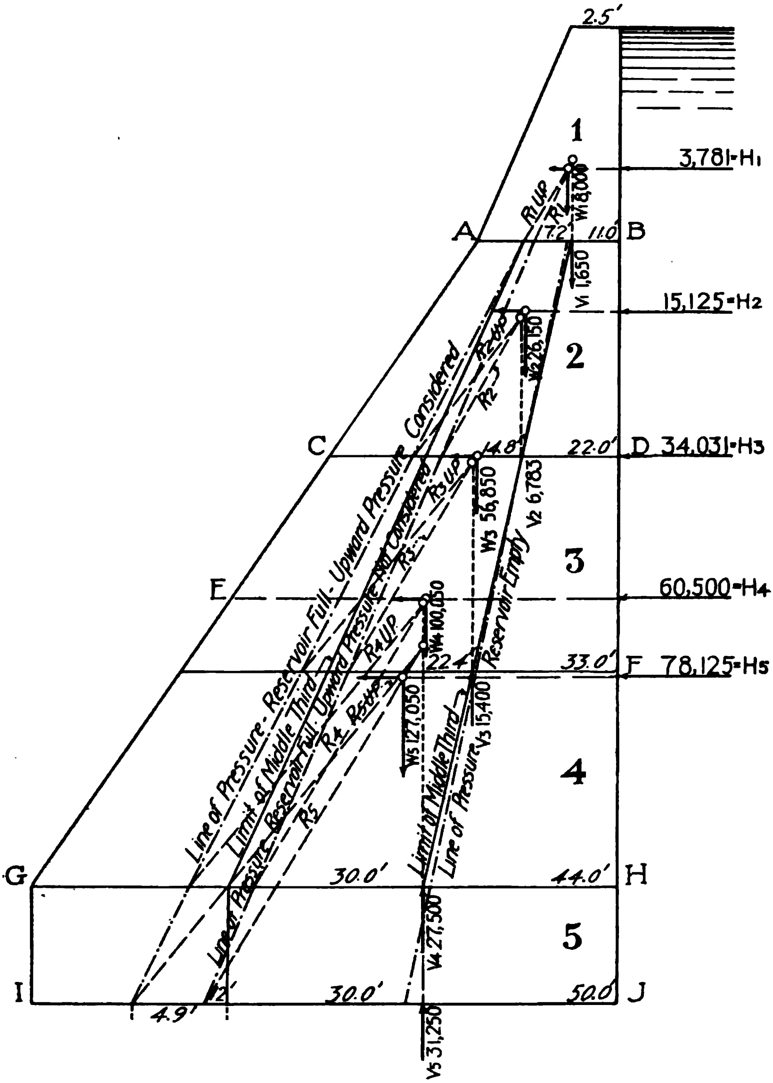
In Case No. 1 the reservoir was assumed to be empty. The line of pressure is found to be slightly within the middle third at the first joint A-B, 11 feet from the top of the dam; below this point it lies just outside of the middle third until the base is reached, where it is slightly within the middle third. The dam may be assumed to be stable under this condition, as the pressures are not large.

In Case No. 2, the reservoir was taken as full, but upward pressure was not assumed as acting upon the dam. The line of pressure is found to lie within the middle third at all joints until the base is reached, where it is 1.2 feet outside of the one-third point. The line of pressure should have been kept within the middle third of the dam at every joint.

In Case No. 3, the reservoir was taken as full, and the dam was assumed to be subjected to upward pressure on the horizontal joints and the base, varying uniformly from two-thirds of the hydrostatic pressure at the upstream face, to zero at the downstream face. The line of pressure is found to lie entirely without the middle third, varying from 0.1 of a foot at joint A-B to 2.0 feet at joint G-H, and 4.9 feet at the base.

The maxima pressures are found to be 4.8 and 6.25 tons per square foot, or 67 and 87 pounds per square inch, respectively in Cases 2 and 3, which are within safe limits.

From the calculations it is evident that this dam exhibited a decided tendency to slide upon a horizontal joint or its base. In Case 3, the required coefficient of friction varies from 0.60 at joint A-B, to 0.82 at the base; and inasmuch as 0.65 is the maximum allowable coefficient for even the most favorable conditions, which certainly did not exist in this structure, it is plainly to be seen that this dam, with its shallow foundations on thin horizontal layers of sandstone, shale and clay, was exceedingly unstable in this respect.



BAYLESS PULP AND PAPER CO. DAM
AT
AUSTIN, PA.

Calculating this in another way, we may say that the sliding resistance of the dam was not over 0.5 of the weight of the dam corrected for upward water pressure, or about 48,000 lbs. per foot of dam. Since the horizontal water pressure was 78,000 lbs., there remains a difference of 30,000 lbs. to be provided for. The only provision to care for this excess pressure was the setting of 1¼″ square, twisted rods, 25 feet long, in the foundation of the dam, 5 feet from the upstream face, and 2 ft. 8 in. apart. For these rods to resist successfully the 30,000 lbs. excess pressure per foot of length of dam it would have been necessary for each one to have resisted in shear a stress of 80,000 lbs., or 51,000 lbs. per square inch, and long before such a stress was reached the concrete would have cracked or split away from the rods.

From the above description and calculations it is evident that this dam was faulty in design and construction in the following respects:

That the effect of upward pressure on the base and horizontal joints was not provided for.

That sufficient provision was not made to prevent sliding on the base or joints.

That care was not taken to prevent the existence of horizontal joints or planes of weakness, and the laitance was not removed.

That the foundation was not excavated to a depth sufficient to prevent the underlying strata from becoming saturated, thus promoting the tendency to slide.

Table No. 10 gives the results of the calculations in the analysis of this structure.

TABLE NO. 10.

Calculations of Bayless Pulp and Paper Company Dam at Austin, Pa.

	Joint considered.	Distance from top—feet.	Horizontal pressure H—lbs.	Weight of masonry W.—lbs.	Upward pressure V.—lbs.	W-V—lbs.	Tan. A.	Moment at upstream edge—Ft., lb.	Xo ft.	Ins'de or outs'de middle 3rd.—ft.	Maximum pressure.	
											Lbs. per sq. in.	Tons per sq. ft.
Case 1—Reservoir empty, ...	A—B,	11	....	8000	....	......	......	....	......	....	......	......
	C—D,	22	....	26150	....	......	......	....	......	....	......	......
	E—F,	33	....	56850	....	......	......	....	......	....	......	......
	G—H,	44	....	100050	....	......	......	....	......	....	......	......
	I—J,	50	....	127050	....	......	......	....	......	....	......	......
Case 2—Reservoir full. No upward pressure.	A—B,	11	3781	8000	....	......	0.47	34850	4.35	In.	......	......
	C—D,	22	15125	26150	....	......	0.58	235300	9.0	In.	......	......
	E—F,	33	34031	56850	....	......	0.60	788000	13.9	In.	......	......
	G—H,	44	60500	100050	....	......	0.60	1872000	18.75	In.	......	......
	I—J,	50	78125	127050	....	......	0.62	2695000	21.2	Out 1.2′	67	4.8
Case 3—Reservoir full. Upward pressure,	A—B,	11	3781	8000	1650	6350	0.60	30630	4.9	Out 0.1	......	......
	C—D,	22	15125	26150	6783	19367	0.78	201900	10.45	Out 0.6	......	......
	E—F,	33	34031	56850	15400	21450	0.82	673000	16.25	Out 1.3	......	......
	G—H,	44	60500	100050	27500	72550	0.83	1597000	22.0	Out 2.0	42	3.0
	I—J,	50	78125	127050	31250	95800	0.82	2382500	24.9	Out 4.9	87	6.25

Weight of concrete—150 lbs. per cubic foot.
Upward Pressure—2-3 hydrostatic pressure at upstream edge to 0 at downstream edge.

Brookville Water Company Dam.

BROOKVILLE WATER COMPANY DAM.

A dam was built by the Brookville Water Company on North Fork Creek, a tributary of Red Bank Creek, in connection with an extension of the water supply system. Construction was begun during December, 1910, and carried on through 1911, until January, 1912, when it was completed. On January 1st, 1912, the water works were purchased by the Borough of Brookville. The dam is within the borough limits, at a point about one-half mile above the mouth of the stream in Red Bank Creek, the total drainage area of North Fork Creek being 97 square miles. The topography of this watershed is rugged, and the percentage of runoff is said to be high and the velocity rapid. Below the dam the stream has a rather wide channel to its mouth. The capacity of the reservoir is said to be 16,500,000 gallons. The dam was severely damaged during a heavy rain which occurred over the watershed on July 17th, 1912.

It is an earthen structure with a concrete spillway, its total length on the crest being 360 feet, and its maximum height above the ground surface 16 feet. The length of the earthen portion is 260 feet and of the spillway section 100 feet, the crest of the spillway being 8 feet below that of the earth work. The earthen portion has a top width of 8 feet, and the up and downstream slopes are 1 on 2, the former slope being paved with from 12 to 18 inches of hand-laid stone riprapping, and the downstream slope seeded. A concrete core wall extends throughout the length of the embankment, its crest being 12 feet below that of the earth work. This core wall has a top width of 9 inches and the sides are battered ¼ in. in one foot; it was also reinforced on the up and downstream faces with steel bars spaced four feet center to center.

The spillway section has a length of 102 feet between abutments, the elevation of the crest being 82 feet and that of the top of the embankment 90 feet, while the natural ground surface is approximately 9 feet below the crest. This masonry portion of the dam has an ogee section with vertical upstream face, the curve below the crest having a radius of two feet, while that at the toe is of six feet radius. The excavation for the foundation for the spillway portion was carried between four and seven feet below the natural ground surface to a stratum of fine clay, of a yellowish color, containing a small percentage of gravel. The spillway has a top width of three feet and a width at the natural ground surface of 7½ feet. The foundation, however, was carried some distance downstream below the natural ground surface, so that the total width at the base is 17 feet. The base of the dam is keyed into the foundation in three places, at the up and downstream toes, and in the center, these keys being two feet wide and one foot deep. It is reported that it was the purpose of the builders to construct the dam on rock foundation, which it was believed would be found at a depth of four feet below the surface, but the foundation was prepared for a distance of about six feet, and no rock was encountered at this depth. It was proposed originally to make a rock fill below the toe of the foundation for a distance of 12 feet, but this fill was not placed. A trench formed in excavating the foundation for the spillway section of the dam was made wider than necessary and was refilled with loose material from the excavation. A 72" blow-off pipe was carried through the dam.

It is estimated that the spillway, below the crest of the embankment at elevation 90, has a carrying capacity of 8,550 cubic feet per second, and that the capacity of the 72" pipe is 650 cubic feet per second, making a total flood discharge capacity of 9,200 cubic feet per second. This would allow of a runoff from the 97 square miles of tributary drainage area at the rate of about 95 second feet per square mile.

After the dam was completed and water allowed to store behind it, a vertical crack was reported in the spillway section, about ⅓ of the distance from the east abutment. The contractors who constructed the spillway section stated that this crack occurs 33 feet from the face of the east wing-wall, at the junction of two construction sections. The entire dam appeared to have been well constructed, especially the concrete portions in the spillway section and core-wall.

On the afternoon of July 17th, 1912, a severe rain occurred in Brookville and over the watershed of North Fork Creek, reaching a maximum intensity between 8 and 10 o'clock in the evening. The local weather observer at Brookville reports that 2.48" of rain fell during the storm, and that, with the exception of the two hour period between 8 and 10 P. M., the intensity of the storm was moderate. From reports received from residents on the watershed above the Borough of Brookville it would appear that the intensity and duration of the rain was greater there than in the borough, although no records were made. The creek began to rise in Brookville at about 6 P. M., and attained its maximum height about midnight. The water rose rapidly in the spillway of the dam, which proved insufficient to pass it, and the water overflowed the earth embankment at each side of the spillway to a depth of approximately 18 inches.

Most of the earthen embankment on the downstream side of the concrete core wall was washed away, and the top of the earthwork on the upstream side of the core-wall was largely washed out and the stone riprapping damaged. Below the spillway section the water cut into the west bank of the stream to a distance of about 30 feet, so that the bank extended along and nearly to the toe of the earthen dam for a considerable distance. The core-wall was apparently well constructed, as it was not damaged in any way, and probably prevented a breach being washed through the earthen portion of the dam. The spillway was uninjured, although a deep hole was washed in the creek bed just below the downstream toe thereof.

No gagings are available to show the actual runoff from North Fork Creek during this flood, although a rough approximation can be made, considering the dam as a weir, the maximum depth of water flowing over the same being 18″ over the embankment and 9′ 6″ over the spillway. Under these assumptions it is estimated that the maximum discharge was at the rate of 12,000 cubic feet per second, which, with a watershed of about 97 square miles, would represent a runoff at the rate of approximately 124 cubic feet per second per square mile.

CLOVER RUN DAM.

A timber crib dam was construced on Clover Run in 1896 by the Punxsutawney Water Company, which company later came under the control of the Lindsey Water Company. The dam is 3½ miles above the mouth of Clover Run, a tributary of the east branch of Mahoning Creek, about seven miles east of the borough of Punxsutawney, and 3½ miles above the borough of Big Run. The drainage area above the dam consists of seven square miles of hilly, cultivated land, while below the dam, to the town of Big Run, the creek has a rapid fall through an uninhabitated valley. The capacity of the reservoir is approximately 65,000,000 gallons. The structure was overtopped and part of it washed out, after a heavy rain, in October, 1911.

The dam was built of hemlock timber, the cribbing being filled with earth and stone. The crest length is 540 feet, and its height, above the elevation of the natural ground surface at the bed of the creek, is about 26 feet. The upstream side of the cribbing was faced with 2½″ oak plank sheeting, against which an earthen embankment was placed on a slope of 1 on 2. The cribbing at each end of the dam is about 17 feet wide on top, the downstream side being perpendicular, and stepped out toward the center of the structure, so that its width on top for a length of 280 feet in the center was 40 feet. The top of the cribbing is about 5 feet below the top of the dam, the upper 5 feet consisting of earth fill. The width of the earthen crest was made 40 feet, and the clay filling continued over the downstream side of the cribbing at a slope of 1 on 1½. Over all except 225 feet of the central part of the dam the cribbing was placed upon the natural ground surface, while in this central part a concrete foundation was constructed, four feet in depth and extending 25 feet downstream from the upstream toe of the cribbing. On this concrete foundation two layers of 2½″ pine plank were secured, and the timber cribbing spiked to the plank. A spillway was provided in the center of the dam, 30 feet long and 2½ feet deep, the sides and bottom of this spillway being planked, and the water carried on a planked slope over the downstream face of the cribbing. A 12″ supply and 20″ blow-off pipe were carried through the bottom of the dam, with gates at their upstream ends.

On October 1st, 1911, after a heavy rain, the spillway was overtaxed and water overflowed the embankment, so that a portion of the earthwork and cribbing in the central part of the structure was washed out. The section destroyed was about 240 feet long and extended to a depth of about 13 feet below the original crest of the earthwork. So far as can be learned, no damage was done in the valley below as a result of this failure. It is believed, from the appearance of the break, and from such descriptions of the failure as could be secured, that the dam failed because of overtopping, due to insufficient spillway. The spillway, 30 feet long and 2½ feet deep, had a discharge capacity estimated at about 350 second feet, and provided for a run-off at the rate of 50 second feet per square mile.

FORT PITT DAM.

During the day on which the Oakford Park Dam failed, another small structure in the same vicinity was wrecked, causing, it is reported, the loss of two lives. This dam was on Bull Run, at a point about ½ mile north of Jeannette, Westmoreland County, the tributary drainage area being 2¼ square miles. It was used to impound water for a glass-works and was about 170 feet long on the crest and 10 feet high, constructed of puddle, faced with compacted cinders from the neighboring glass-works. The spillway in the embankment was 45 feet wide and 3 feet deep, and had a capacity of 700 second feet, providing for a run-off at the rate of 310 second feet per square mile of tributary drainage area.

During the heavy rainstorm of July 5th, 1903, the run-off exceeded the capacity of this spillway and the embankment was overtopped a few inches. A breach was washed through the structure, about 90 feet long and to the full depth of the embankment. Bull Run, below the dam, flows through the borough of Jeannette, and the failure is reported to have cost the loss of two lives and considerable property. A previous failure of this dam occurred in 1896.

GREEN LICK RUN DAM.

An earthen dam, built on Green Lick Run, by the Citizens Water Company of Scottdale, failed three years subsequent to its completion in 1901, from percolation through the foundation or lower strata of embankment. The structure was built across Green Lick Run, 2¼ miles above its mouth, in Jacobs Creek, and 5½ miles above the borough of Scottdale. The tributary drainage area consists of approximately 1⅓ square miles of mountainous country.

The dam had a length on the crest of 850 feet and a maximum height above the original ground surface of about 60 feet. The width of the crest of the embankment was 6 feet, the upstream slope 1 on 2, and the downstream slope 1 on 1.7. The spillway was at the northern end; the area of the water surface was 25.4 acres, and the capacity of the reservoir 166,500,000 gallons.

The overburden in the valley of Green Lick Run at the dam site consists of drift material, comprised of sand, gravel, boulders, and clay. Starting at the northern end of the dam, for a length of about 100 feet this overburden is yellow clay, to an average depth of about 10 feet. South of this for a length of 250 feet, in the low part of the valley, is a deposit of gravel and boulders, of depth varying between 3 and 12 feet. For the remaining distance to the south, the yellow clay reappears, containing deposits of sand, gravel, and boulders, varying in depth between 7 and 25 feet. Beneath these deposits the geological structure of the valley is as follows:—

The northern hillside consists of successive outcroppings of blue shale, sandstone, shale, coal, slatey shale, coal, shale and limestone. The limestone occurs at the foot of the northern hillside, and it is seamy and porous. The direction of the center line of the dam is north 24 degrees west; and the strike of the limestone rock makes an angle of 77° 10′ with it. The dip of the rock is north 36° 50′ west, making an angle with the horizontal of 27° 10′. South of the limestone strata, the underlying material of the valley consists of blue shale or fire clay.

In preparing the site for the embankment only the surface material was stripped. A trench was, however, carried across the valley, along the center line of the dam, to a varying depth, but which did not extend, so far as could be learned, into the limestone, shale and sandstone rock at the northern end, or into the blue shale throughout the remaining width of the valley. The trench was backfilled with puddle, but did not serve the purpose of a cut-off, as shown by the excessive leakage which appeared below the dam.

The embankment is reported to have been built of a gravelly clay, suitable for the purpose, placed in 6-in. layers and rolled, the up and downstream faces being covered with 18 inches of stone riprapping. A considerable portion was built during the winter months, and was placed in a frozen condition, so that there was noticeable settlement in the spring, and excessive leakage through the earthwork. An attempt was made to stop this leakage by constructing a puddle cut-off throughout the length and along the center line of the embankment, which cut-off is reported to have been carried to a depth of between 25 and 30 feet below the crest. It did not, however, entirely cut off the seepage through the embankment.

The spillway, which was constructed by excavation into blue shale. was 36 feet long, and 4 feet deep below the crest of the embankment. Its capacity was approximately 950 second feet, which would provide for a run-off at the rate of about 700 second feet per square mile, and it was therefore of ample dimensions. Three pipe lines were carried through the embankment, one a 24" blow-off, and two supply lines, 16 and 20 inches in diameter. The valves were below the downstream side of the embankment.

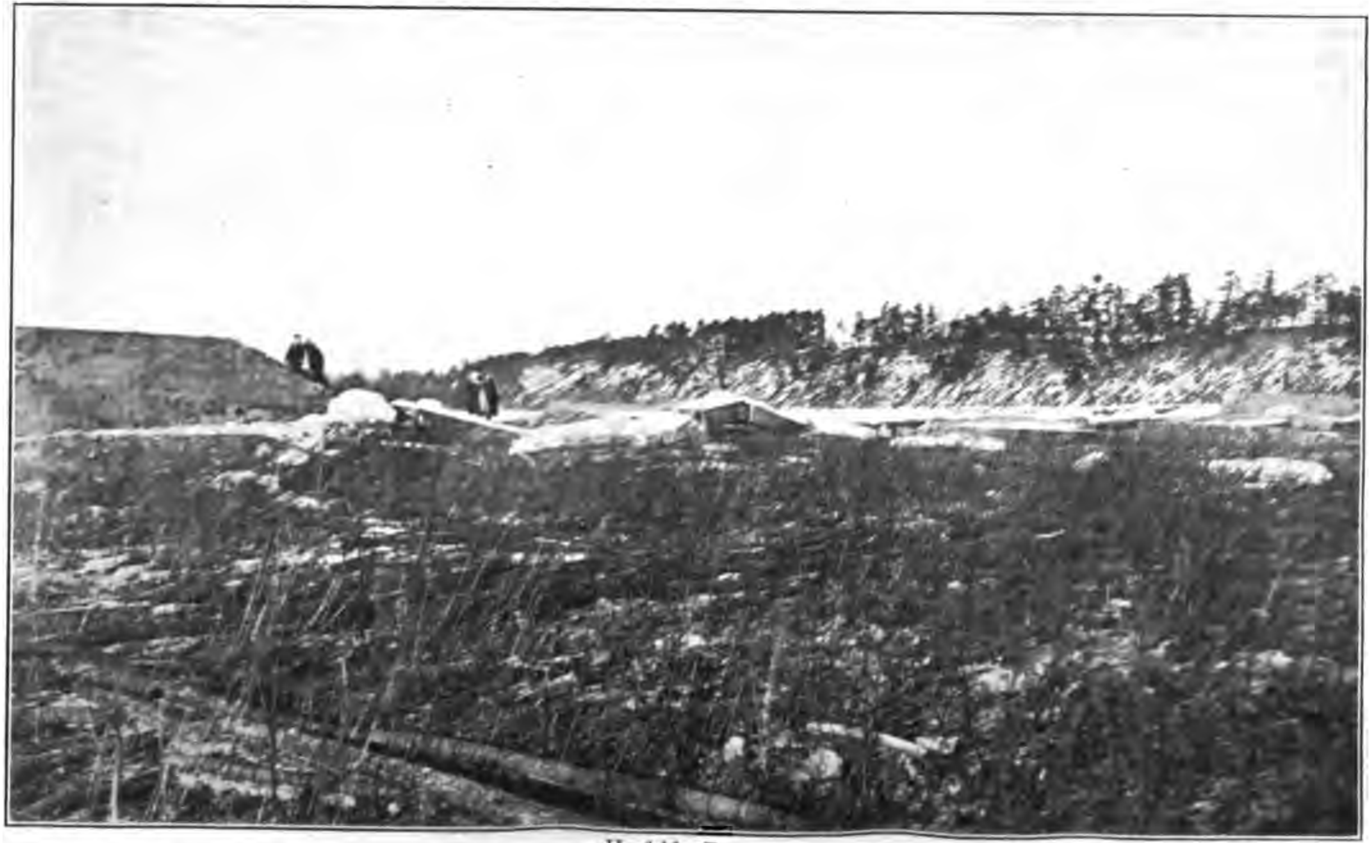
After the dam was completed and the reservoir filled leakage occurred through and underneath the embankment, much of it appearing at a point about 150 feet below the downstream toe. A small catch-basin was then constructed about 300 feet below the embankment, in which this escaping water was collected, and a pump was installed to force it back into the reservoir.

A leak was discovered in the embankment at the northern end of the dam in the morning of July 17th, 1904, and the people in the valley below were warned of its unsafe condition. At about 10 P. M. of the same day a breach was washed through the dam, about 150 feet wide on top and extending to the foundation, exposing the limestone and shale rock of the hillside. The failure is reported to have been very sudden, and was caused, it is believed, partly by the saturated condition of the embankment and partly by seepage which occurred through the fissured limestone and gravel underneath the puddle cutoff wall. This leakage kept increasing in amount and velocity so as to lubricate the rock and undermine the embankment, finally allowing a prism of the earth-work to be forced out.

Below the dam the valley of Green Lick Run is about one-eighth of a mile wide, and the water is reported to have risen to a height of between 6 and 8 feet. There were few houses in the valley below the dam, and these were either destroyed or badly damaged, but the timely warning prevented loss of life. Several bridges which crossed the creek below the dam were destroyed. After the failure the dam was repaired, and some years later the company changed ownership, and more extensive alterations were undertaken. This repair work, in a general way, consisted of facing the upstream slope with selected impervious material, and facing the same with 12 inches of masonry. Along the upstream toe a trench was carried across the valley to varying depths, into the shale and limestone rock, and backfilled with 4 feet of puddle and 2 feet of masonry. The dam has since satisfactorily served its purpose.

HOSFELD DAM.

A long, low concrete dam was constructed in 1908-11, across Conodoguinet Creek, near Shippensburg, for the purpose of securing head and pondage to operate a small hydro-electric plant to fur-



Hosfeld Dam.

nish power to the Shippensburg Gas and Electric Company. Construction on this dam was started in the summer of 1908, and was completed in September, 1911. The dam was designed by a man who was not an engineer, and was constructed under his direction by day labor. The dam failed in part several times subsequent to its completion in 1911, the latest and most disastrous failure occurring on January 17th, 1912.

It was built across Conodoguinet Creek, about three miles below its gap through North Mountain, the tributary drainage area being 36 square miles. The east bank of the creek at this point is quite precipitous, consisting of slate rock and is about 50 feet high. From this bank the dam crosses the stream at right angles for a length of two hundred feet, and thence turns toward the south across low flat land, to meet the creek again at the power-house, the total length of the wall being about 3,070 feet. It was constructed of 1-2-4 concrete, in which large stones were imbedded, the mass, however, forming a rather poor quality of masonry.

The first 200 foot section was designed to act as a spillway, its height above the natural ground surface being a little over 10 feet, and above the foundation 13 feet. This section is three feet wide on top, and five feet wide on the base, and is made homogeneous with a concrete base 12 feet wide on top and 3 feet deep, for 10 feet of its length, and 4.5 feet deep for the lower 2 feet, the top of the lower 7 foot section acting as an apron. The foundation for the dam, from the cliff across the creek bed, is said to be rock, and for the remainder of its length gravel and clay.

The second section, which is 8″ higher than the first, and 820 feet long, acts as an auxiliary spillway; its width on top being 2 feet, and on the base 3.5 feet, with the same type of concrete foundation, and a 5 foot apron at the toe; the total height of this section above the foundation being 12½ feet. The top of the remaining portion is 8″ above that of the previously described section, and of the same general dimensions, although the total height gradually diminishes, owing to the ascending ground. An earth fill was placed against the upstream side and a number of buttresses against the downstream portion of this wall. A buttress was also constructed against the downstream face of the wall across the creek channel, about 20 feet from the slate cliff. Through the bottom of this portion of the wall a 36″ outlet pipe was carried, with a gate at the upstream side thereof. The reservoir submerges an area of 40 or 50 acres, and afforded sufficient pondage for the daily fluctuations in head, due to the operation of the plant.

The first failure occurred shortly after it was built, at a point about 2,400 feet beyond its east end, the primary cause being the percolation of water between the dam and its foundation. A short portion of the wall had been constructed over an old timber flume, which, when the water raised behind the dam, was washed out, causing the wall to collapse. This section was immediately rebuilt on a gravel foundation, and the reservoir again allowed to fill.

The second failure occurred during the night of January 17th, after the power plant had been shut down, there being no witnesses to this failure. Ice had formed over the reservoir to a thickness of about 14 inches, the top of the ice being about 2 feet below the crest of the auxiliary spillway section. In the operation of the plant, the water had been drawn down about three feet, two feet more than was customary, and the ice broke and settled several feet away from the face of the wall, leaving a fan shaped piece adhering to the wall, which had frozen against the masonry to a thickness of between 2 and 3 feet. When the water rose during the night the ice was forced up, and probably exerted a constantly increasing pressure or leverage against the wall, causing a section 330 feet long, and about 200 feet distant from the end of the first spillway section, to overturn.

The wall broke into nine large and a number of smaller pieces, the largest being about 70 feet long. From the position of these pieces, as is indicated on the plan, it would appear that the center of this section was the first to collapse. Pieces A, B, C, D, G, H and I, and the smaller fragments beyond them, appeared to have simply fallen over on their downstream faces, and were lying about 30 feet below their original position. Piece D′ lay on its downstream face, about 180 feet below the dam, and is the upper portion of the fragment D which overturned on the foundation, and lies only a few feet below its original position. The piece D′ was about 35 feet long and about 5 feet in depth, its base and the top of D being comparatively smooth, indicating a construction joint. The piece E lay about 100 feet, and the piece F 40 feet, below the original position of this section of the dam.

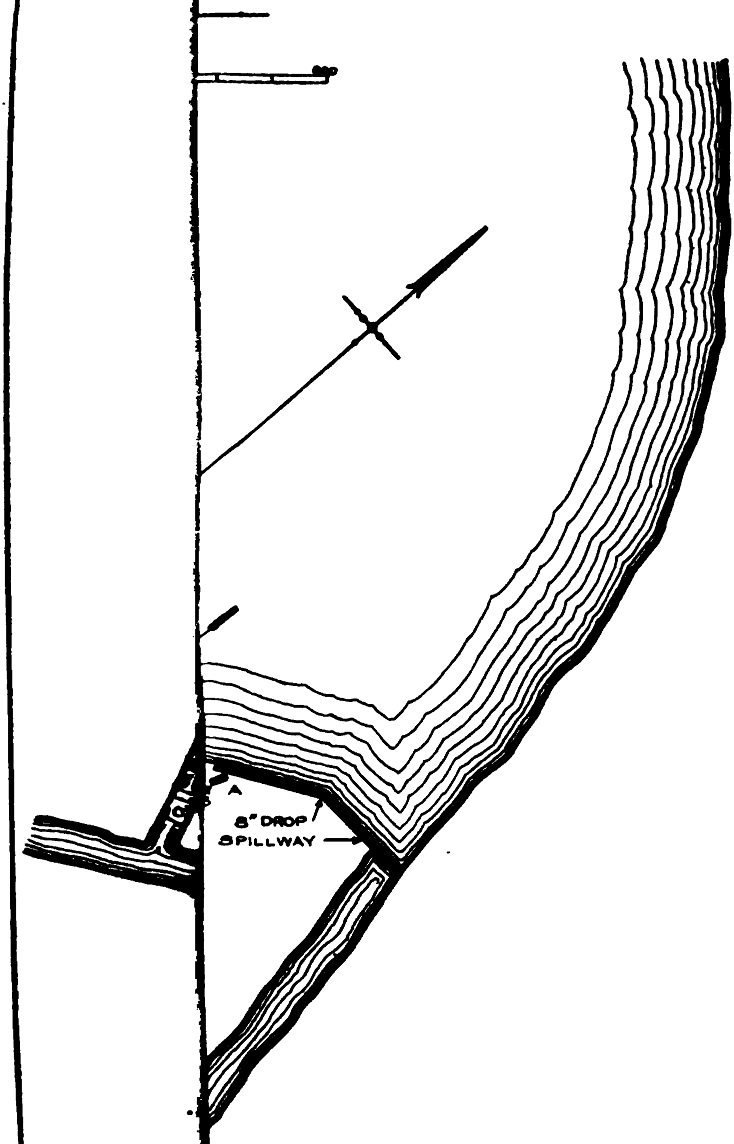
An examination of the fragments indicated that the structure apparently failed by overturning on the gravel foundation, piece D′ also overturning along a construction joint. A portion of the concrete base below the concrete face remained in place, the concrete breaking off along the line G-I, represented on the sketch of the cross-section. It was stated that the portion of the wall between the end of the eastern 200 foot section of the spillway, and the portion which failed, showed a crack at the angle between the downstream face and the apron of the foundation, apparently indicating that this section also started to overturn, and fell back in place again when the pressure of the water and ice was relieved.

In the accompanying drawing a typical section is given of that portion of the dam which failed, and plotted on it are limiting lines of pressure for reservoir empty and reservoir full, assuming the full

LD DAM

: SHIPPENSBURG, PA.

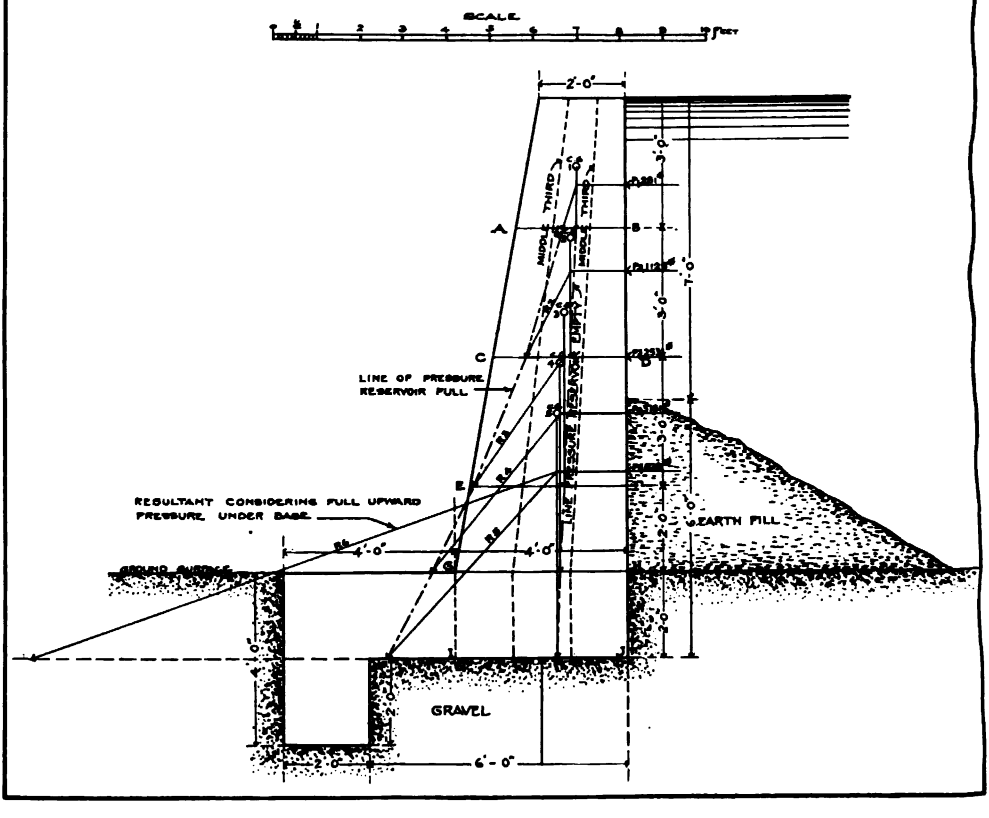
AFTER FAILURE



JOHN HOSEFELD DAM

ON

CONNODOGUINET CREEK NEAR SHIPPENSBURG, PA.



hydrostatic head to be effective to the base and the weight of the masonry at 140 lbs. per cubic foot. The position of the lines of pressure under these assumed conditions are shown only for the purpose of indicating that the design and construction was faulty, and not for the purpose of portraying actual conditions at the time of failure. Needless to say, the determination of the stresses would depend upon a number of conditions which can only be approximated, the earth and gravel fill tending to reduce the pressure against the lower section of the wall, and the nature of the foundation leading one to expect that there was upward pressure on the base. The ice pressure, with a lever arm of about three feet, was undoubtedly great, and it is believed that the dam must have failed before the pressure could have reached its possible maximum.

KAUFFMAN RUN DAM.

The Kauffman Run Dam, which was built in 1886 by the Pottsville Water Company, is on Kauffman Run, a tributary of the Schuylkill River, in Schuylkill County, Pa., about six miles north of Pottsville. The stream drains 0.9 of a square mile of barren mountain land, and below the dam it has a rapid fall and is confined between steep hills. The stream is followed by the Pennsylvania and the Philadelphia and Reading Railroads, and the first settlement below the structure is the small borough of St. Clair.

The Kauffman Run reservoir has a capacity of 120,000,000 gallons; it is located about one mile below the source of the stream, and the drainage area tributary to the dam is 0.78 square miles. This dam partially failed in 1892, necessitating its re-construction.

The original structure was an earthen dam, 55 feet high, and 800 feet long on the crest. Its top width was 20 feet; the upstream slope 1 on 2, and the downstream slope 1 on 1½, both slopes being riprapped. The embankment consisted of sandy clay, and contained a small percentage of red shale. There was a puddle core through the center of the embankment, 10 feet thick, founded on red shale. Two 12" pipes were carried through the embankment, one for supply and the other as a blow-off. It is reported that neither of these pipes was provided with collars or cut-offs. The spillway was 50 feet long and 5 feet deep.

Leakage appeared in the downstream face of the embankment, about half way up the slope, and 25 feet above the outlet pipe. It was observed in the morning, and the flow increased in quantity until noon of the following day. When the leakage was discovered the valve in the outlet pipe was opened, and the water lowered in the reservoir, so that the leakage stopped. It was not however of sufficient amount or duration to cause a breach through the embankment, and the prompt action of the company in drawing off the water in the reservoir probably saved the dam from complete destruction.

The officers of the Pottsville Water Company, upon the advice of engineers decided that it would be unwise to attempt to use the dam, or to endeavor to repair the structure by cutting off the leakage. It was, therefore, decided that it should be entirely rebuilt, which work was started in 1896. The new dam was built just below the old one, and part of the embankment was formed of selected material secured from the old structure. The new dam contained a concrete core-wall, 9 feet wide at the bottom and 3 feet wide on top, which was founded on shale rock. The width on top was made 20 feet, and the slopes of the embankment were 1½ to 1 on the downstream side, and 2 to 1 on the upstream side. The spillway was made of the same dimensions as that of the old one, namely, 50 feet long and 5 feet deep; the capacity of which was ample, being about 1,700 second feet.

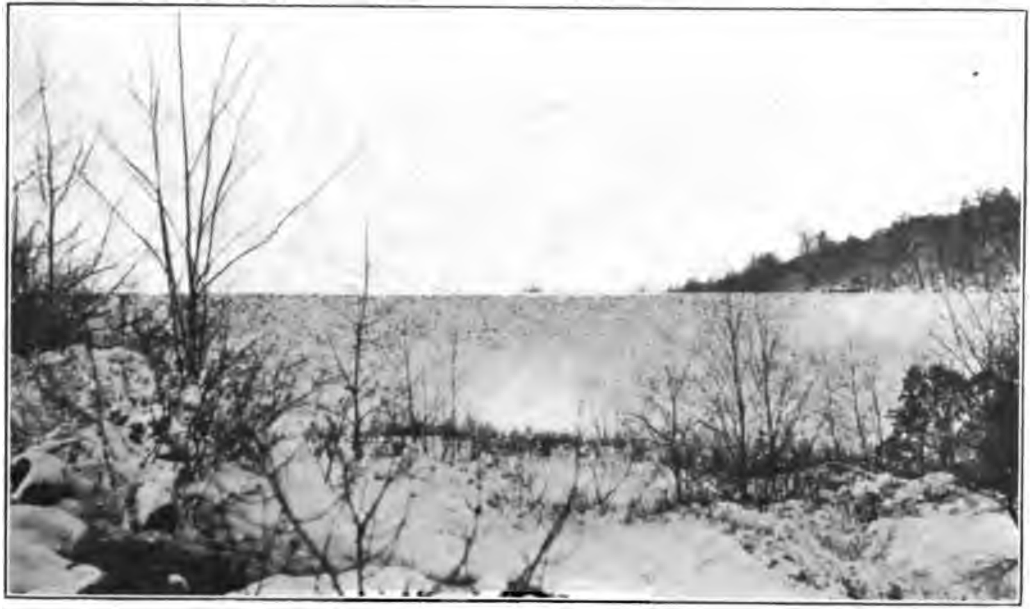
KETNER DAM.

A dam belonging to the Buffalo, Rochester & Pittsburgh Railway Company, on Johnson Run, near Johnsonburg, failed when about 50 per cent. completed, on August 28th, 1911, about one month before the failure of the Austin Dam. Immediately after the failure, the dam was re-built, with however some slight modifications in the design and was put in service in July 1912.

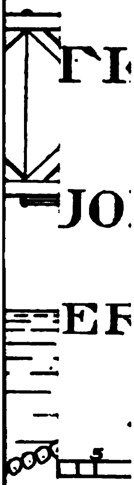
The estimated capacity of the reservoir formed by this structure is 92 million gallons. It was being built for the purpose of impounding water for the railway company, at Johnsonburg, about 5 miles below the site of the dam, on the Clarion River. Johnson Run is a tributary of the Clarion River, joining that stream about 4 miles above Johnsonburg. Its drainage area is 11 square miles, while that tributary to the dam is approximately 8 square miles, consisting of uninhabited, deforested mountain land. Between the site of the dam and the borough of Johnsonburg the valleys of Johnson Run and the Clarion River are wide and practically uninhabited.

The dam is an earth structure, with a concrete core-wall and spillways at each end, the length on the crest, exclusive of the spillways, being 597 feet, and the width on the crest 16 feet. The maximum height above the natural ground surface is 45 feet, and the width on the base, in the maximum section, 218 feet. The upstream slope is 1 on 2½, and the downstream slope 1 on 2. The elevation of the crest is 1,560 feet, of the east spillway 1,556.5 feet, and of the west spillway 1555 feet.

In preparing the foundation for the earth fill the site was carefully stripped to the depth penetrated by roots. The excavation for the core-wall was carried to varying depths below the original ground surface, a portion of the prepared foundation consisting of rock, and the remainder of hardpan. The rock foundation was en-



Kauffman Run Dam as Rebuilt.



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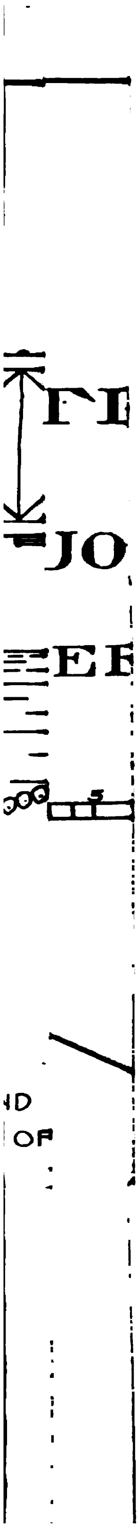

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countered on the east and west sides of the valley, and extended for a length of 220 feet from the east spillway, and 134.5 feet from the west spillway. The remainder of the foundation consisted of hard shale; the total length of said foundation being 242.5 feet. In this hardpan foundation a pit was dug to a depth of 6 or 7 feet, and an iron bar driven 8 feet further, without encountering rock. The core-wall was carried into the rock for a distance of 9 feet at the east end and 8 feet at the west end. The depth of the excavation for the rock foundation at the west end of the dam varied between 7 and 15 feet, and at the east end between 12 and 20 feet. The depth of the excavation to the hardpan foundation varied between 10 feet and 25 feet.

The upstream side of the embankment was constructed of a shale and clay fill, wetted and rolled in from 6 to 12 inch layers, by means of a 4-ton road roller. The selected clay fill was placed against the upstream side of the core-wall, having a thickness of 2 feet at the crest and of 12 feet on the base. The downstream portion of the embankment was made of shale and clay, containing, however, a greater proportion of shale rock. This portion of the embankment was wetted, but not rolled. The upstream slope of the embankment was protected by means of stone paving, one foot in thickness. Along the upstream face of the embankment, at a point 5 feet in vertical distance below the crest thereof, a timber breakwater was carried throughout the length of the dam, which extended to the height of the crest of the embankment. The plans did not provide for paving the downstream slope, except for a distance of 34 feet above the toe.

The core-wall was constructed of 1-3-6 concrete, with $\frac{7}{8}''$ twisted steel bars, placed 6 feet, center to center, near the upstream and downstream faces. It was 1.5 feet wide on top, while at the natural ground surface, and to a point within 4 feet of the faundation, it was 10 feet wide, at which point the footing was spread to 14 feet. The plans indicated the possible necessity for the use of sheet piling, although the foundation was found to be such as to make its use unnecessary. At the upstream toe of the embankment a concrete cut-off wall was carried to a depth of three feet below the prepared ground surface. This wall was 12 inches thick, and was carried over the upstream face for a length of 4 feet, to meet the stone paving.

The main spillway is at the west end of the dam; its length being 71 feet, and the depth below the crest of the embankment 5 feet. The auxiliary spillway is at the east end of the dam, 35 feet long and 3.5 feet below the crest of the embankment. These spillways have a combined capacity of approximately 3400 second feet, with water level with the crest of the dam, and provide for a discharge at the rate of 425 second feet per square mile of the tributary drainage area.

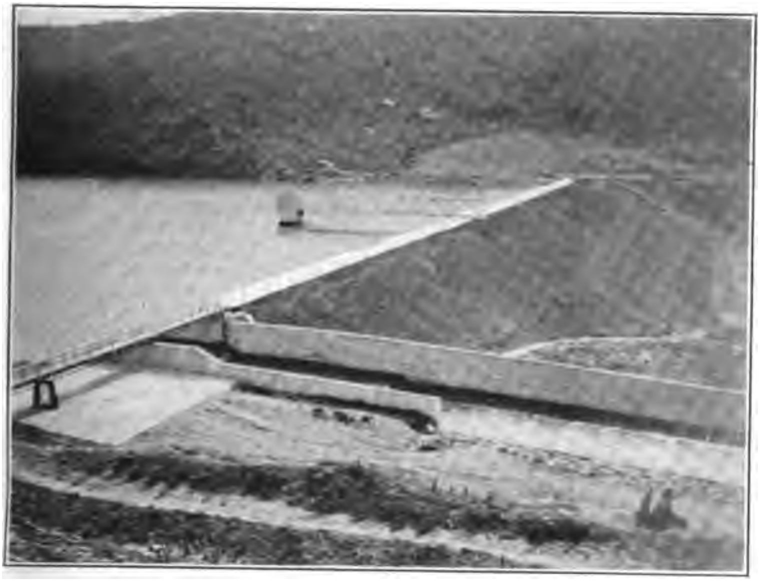
The wasteways are carried along the hillside, so as to discharge into the natural creek channel, well below the toe of the downstream slope.

The concrete gate-house, at the upstream toe, is connected with the crest by a bridge. Four outlets pierce the embankment in the center of the valley, two being 30 inches and two 12 inches in diameter; all of these pipes are encased in concrete.

The first work done consisted in the construction of the core-wall throughout its entire length, and to its final elevation of 1,560 feet, which is that of the crest of the embankment. During this time the fill was being placed against the upstream side of this core-wall, but little fill was deposited against the downstream side. At the time of the failure the core-wall was completed, and the fill on the upstream side had been carried up to an elevation 15 feet below the top of the core-wall, and little filling had been done on the lower side.

For two days previous to the break in the dam, on August 26th and 27th, there was precipitation on this watershed; but the two 30″ outlet pipes were able to take care of the runoff, without filling the reservoir more than 8 or 9 feet. On the following day, August 28th, the rain was exceedingly heavy, described locally as a cloud-burst, and by 11 A. M. the water had risen behind the dam to a depth of 4 feet above the outlet pipes. The water remained at this elevation until 2 P. M., when it again started to rise slowly. The company then put a force of men at work drilling holes through the core-wall, for the purpose of allowing the water to escape. These holes, 50 in number were drilled 5 feet apart. By 8 or 9 o'clock that night the core-wall is reported to have been between 4 and 5 feet out of alignment on the crest, and drilling was stopped. The water was then within 8 feet of the crest of the west spillway, and therefore about 2 feet over the crest of the embankment which had been placed up until that time. Between 10 and 11 P. M. the water had risen to within 4 feet of the crest of the spillway, and at 11 P. M. the core-wall and embankment failed. The core-wall was destroyed throughout almost its entire length, by overturning at a point near the filling line on its downstream side. The entire reservoir, containing approximately 70 million gallons, was practically emptied at once, and this water formed a flood wave, which extended down the Johnson Run and Clarion River valleys to Johnsonburg.

The breach formed through the dam was 400 feet long at the crest of the core-wall, and 38 feet in height between the crest of the core-wall and the part of it which remained in place. The core-wall remaining at the west end was 170 feet long on the crest, and 220 feet at the base; and at the east end 16 feet long on the crest, and 53 feet long at the base. A portion of the earth fill remained against the upstream side of the remaining portion of the



Ketner Dam—as Completed.

spillway, the depth of this fill being approximately 15 feet, indicating that there must have been about this depth of fill against the downstream face at the core-wall at the time of the failure.

The valley of Johnson Run below the dam was uninhabited and the only destruction caused therein by the flood consisted in the demolition of a township highway bridge, situated approximately 1,000 feet below the dam. Upon reaching the Clarion River the force of the flood was largely dissipated in the wide valley, and by the time it reached Johnsonburg it affected only a rise of a few feet and caused no apparent damage.

KITTANNING POINT DAM.

The Kittanning Point Dam, built in 1876-7, was the first structure built on Burgoon Run by the city of Altoona, its purpose being to impound water for a gravity supply. The reservoir is the upper one in "Horse Shoe Curve," and the drainage area tributary to it is 8.1 square miles. The area of the water surface, at the elevation of the spillway, is 12.62 acres; and the storage capacity is about 65,000,000 gallons.

The dam was constructed of red shale and clay, without a core-wall or puddled upstream face; its length on the crest being 650 feet, and the maximum height 50 feet. The top width is 18 feet, and the up and downstream slopes 1 on 2½ and 1 on 2, respectively. Loose stone riprapping, about two feet thick, was placed on both slopes of the embankment, but not on the crest. The spillway is at the west end of the dam, 34 feet long and 5.3 feet below the crest of the embankment. The present flood channel around the reservoir was constructed after the failure. A six foot circular masonry conduit, containing 16 and 12-in. supply mains, passes through the embankment. A gate tower is at the upstream toe, near the center of the dam, and a gate-house at the downstream end of the conduit.

The spillway opening, originally lined on bottom and sides with timber, was destroyed in 1886 during a flood, and subsequently rebuilt. In 1887 work was started upon a masonry spillway which was completed in 1888. The capacity of the spillway is estimated at 1,370 cubic feet per second, and the opening is sufficient to discharge a flood at the rate of 169 second feet per square mile of tributary drainage area.

On May 20th, 1894, the Kittanning Point Dam was damaged during a flood by water flowing over the crest of the embankment. A breach was not, however, washed through the embankment, although it was narrowly averted and probably would have occurred had the flood extended over a longer period. The damage resulted from insufficient spillway capacity; the reservoir was full when the storm began and for some days previous, while, at the time of the flood, two 8 inch and four 4-inch pipes, attached to the 16" and 12" supply mains, were open.

The flood was caused by a heavy rainstorm or cloud-burst, and data with regard thereto is contained in a letter from Dr. Charles B. Dudley, Chemist of the Pennsylvania Railroad Company, to Mr. Harvey Linton, City Engineer of Altoona, published in the Engineering News of June 28th, 1894, Mr. Dudley wrote:

> "The storm began here Wednesday afternoon, May 16, and up to Thursday noon the rainfall was 0.77 inches. Between that and Friday noon it was 0.07 inches. Between that and Saturday noon it was 0.60 inches. From Saturday noon to 6 o'clock Saturday evening 1.67 inches more rain fell. From 6 o'clock Saturday evening until Sunday noon 1.97 inches more rain fell, and from Sunday noon to Monday noon 1.28 inches more. From Monday noon to Tuesday noon 0.08 inches, and from Tuesday noon to Wednesday noon 0.33 inches, more rain fell. This makes a total of 6.77 inches in seven days. Our rain gauge is patterned after the signal service rain gauge, and is, we believe, thoroughly reliable."

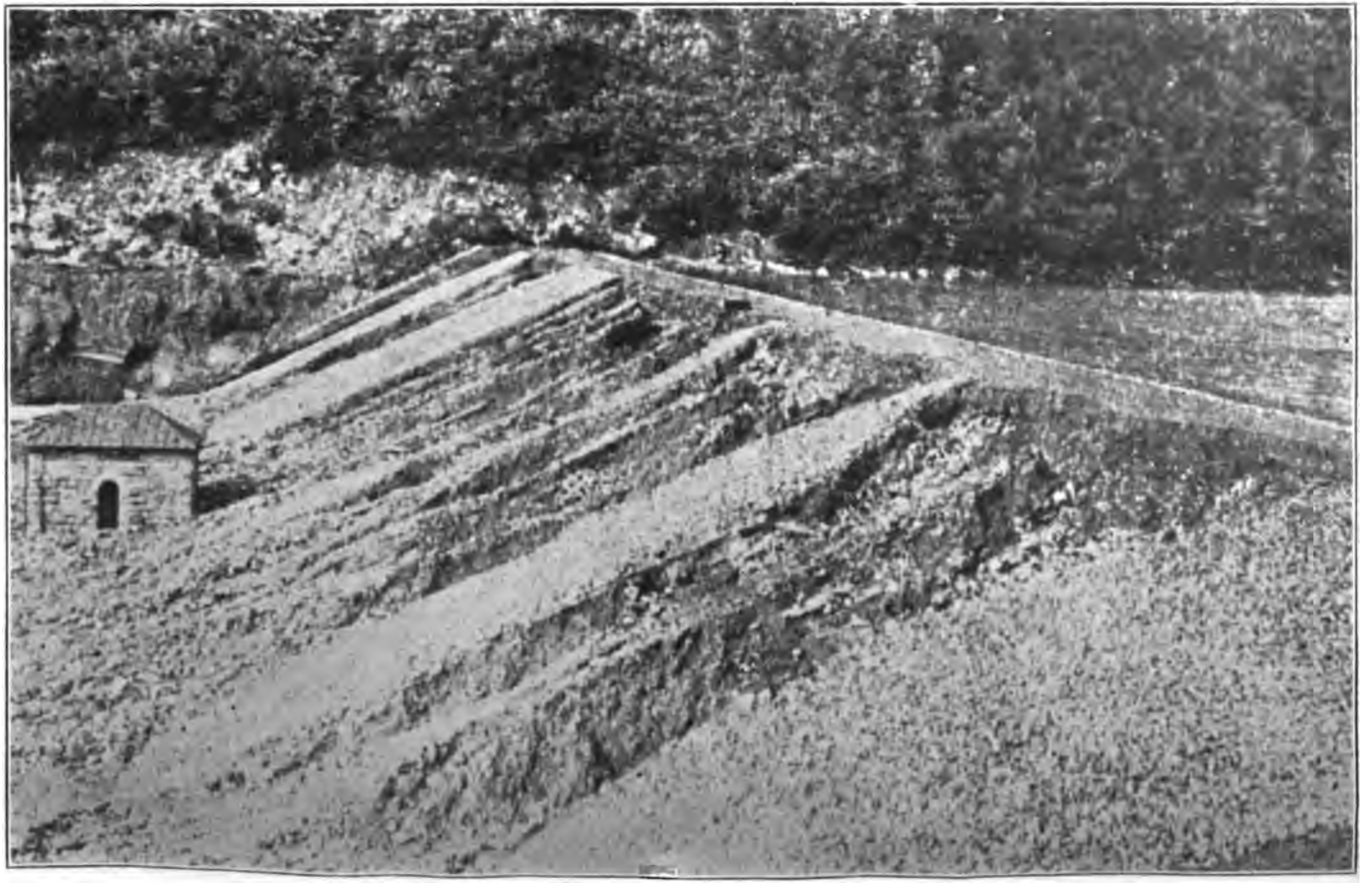
The overflow at the dam occured on Sunday, and the total rainfall at this time amounted to between five and six inches.

Mr. S. A. Gailey, Superintendent of the Altoona Water Works, gave his theory of the cause of the overflow of the embankment to be as follows, in the Engineering News, June 28th 1894:

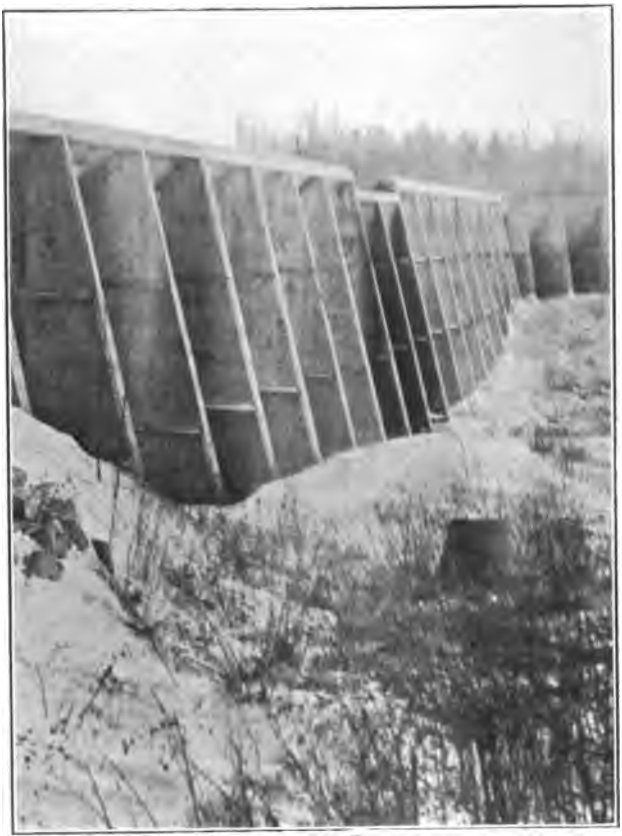
> "In the 'Glen White Hollow,' a few miles above the storage reservoir, there was at one time a sawmill. The rubbish from this old mill made 'three or four jams' in the stream below. These obstructions giving away one after another, or almost simultaneously, allowed a considerable amount of water to flow into the reservoir, in addition to the surface flow. This sudden rise of the water caused the damage, and the time during which the water overflowed the embankment was, in my opinion, much less than half an hour, probably not more than ten or fifteen minutes."

In the first account of the accident, contained in the edition of the Engineering News of June 7th, the correspondent wrote that the water flowed over the embankment for about 30 minutes, according to statements of eye-witnesses, and that for less than ten minutes the depth of the overflow was about one foot.

The overflow eroded considerably the downstream portion of the embankment. Beginning at the west end of the dam, the first break occurred at a point 26 feet from the spillway, and extended for a length of 90 feet, about 8 feet deep. The next important erosion began 64 feet farther toward the east, and was 139 feet long and about 6 feet deep. Then followed only 10 feet of unbroken slope, succeeded by 77 feet of break about 8 feet deep; then ten more feet of undamaged slope, and finally a break 65 feet long and ten feet



Kittanning Point Dam.



Lake Leigh Dam.

deep, terminating some 75 feet from the east end of the main embankment. The dam was repaired after the flood and has remained in service ever since.

LAKE LEIGH DAM.

This dam is one of three which were constructed at the headwaters of Kitchen Creek, between the years 1903 and 1906, to give pondage for a proposed hydro-electric development; the total storage in the three reservoirs amounting to 1,600,000,000 gallons, with a tributary drainage area of 6 square miles. The reservoirs impounded by these dams are known as Lakes Jean, Rose and Leigh; the first of which lies partly in Luzerne county and partly in Sullivan county, while the two latter are entirely in Luzerne County.

The Lake Leigh dam is on the Leigh Branch of Kitchen Creek, about a mile and a quarter above its junction with the Ganoga Branch. It was built in 1906 by the Ambursen Hydraulic Construction Company, and impounds a reservoir 105 acres in area, with a storage estimated at 500,000,000 gallons, and a tributary drainage area of 1.65 square miles.

In 1909, and again in 1911, this dam suffered an incipient failure, by the development of copious leaks beneath the cut-off wall of the concrete section.

Below Lake Leigh the stream flows through a gorge-like glen, with a total fall of 1,200 feet in about 2½ miles. Beyond this, for a distance of about 5 miles, to its junction with Huntingdon Creek, the fall of the stream is less rapid, and it is followed by a public highway, along which are several farmhouses. The town of Harveyville, with a population of about 250, is on Huntingdon Creek, about 1¼ miles below the mouth of Kitchen Creek; and two and four miles farther on are the villages of Huntingdon Mills and Watertown, with populations of 150 and 75, respectively.

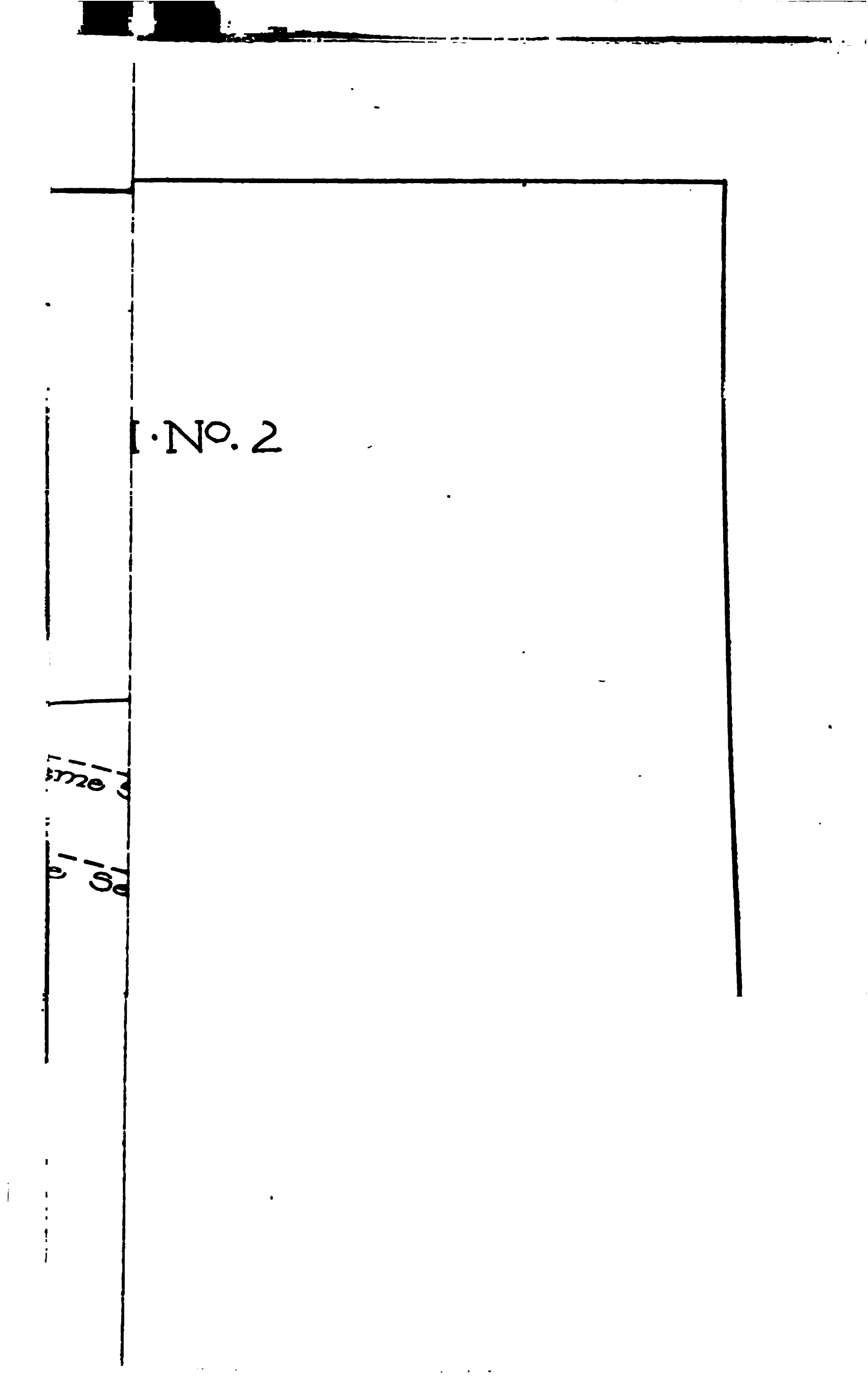
The dam is of the hollow, reinforced concrete type, and is 32 feet high at the maximum section, and 320 feet long, exclusive of earthen embankments at each end. The spillway, 24 feet long and 2 feet deep, is at about the middle of the concrete section. No apron is provided on the downstream side of the spillway. There are three outlet pipes, one at the middle of the dam, 31 feet below its crest, and two near one end, 12 feet and 20 feet below its crest.

The earth embankments at the ends, 204 feet and 168 feet long, respectively, are provided with concrete core-walls, and the slopes are protected with riprap.

The concrete portion consists of buttresses, supporting slabs of reinforced concrete which are inclined at an angle of 45 degrees. The geological formation of the valley is said to be sandstone or conglomerate rock, with a thin overburden of soil, and the buttress footings and cut-off wall are reported to have been carried down t full bearing upon the rock. The buttresses, which are 12 feet o centers, were built in 9′ 6″ lifts, and are 12 inches thick at the to increasing in thickness by 4 inches at each lift. The maximum compressive stress in the buttresses, which are of 1-3-6 concrete, wa found to be 5.8 tons per square foot, and at no place were they i tension. The deck slab is of 1-2-4 concrete, 10 inches thick, rei forced with ¾″ square bars, 6 inches on centers, for a vertical di tance of 12 feet below the crest. It thence gradually increases i thickness to 16 inches at the bottom, where the ¾″ bars are 4½ center to center. The unit stresses in the deck slab are high, th minimum, which occurs at the 10″ section, being 15,350 lbs. pe square inch in the steel, and 810 lbs. per square inch in the concret and the maximum, which occurs at the 16″ section, being 19,600 lb per square inch in the steel, and 874 lbs. per sq. in. in the concret The maximum shear stress in the concrete was found to be 74 lbs. pe square inch.

Calculations of the stability of the dam against overturning sho that the resultant intersects the base 16.7 feet from the toe, or 4.5 feet within the middle third. The total combined weight of the masonry and water acting at the bottom of the highest buttress is 540,000 lbs., which gives a maximum pressure of 4.6 tons per square foo on the foundations. The maximum coefficient of sliding reveale by the calculations is 0.73.

In 1909 a leak appeared under the dam, the water evidently bein forced beneath the upstream toe or cut-off wall, and rising under th deck in five days. The water was drawn from the reservoir, and th Ambursen Company employed to stop the leakage. It was though that in constructing the cut-off wall the rock foundation in the trenc had not been properly cleaned, and that the water was forced between the rock and the concrete footing. In order to repair this, trench was dug along both sides of the footing, the rock thoroughl cleaned, and concrete laid against the footing. When the reservoi was refilled the leaks did not reappear. In 1911, however, a large leak developed near the spillway, though not in one of the bays in which the previous leak had occurred. The water was forced under the footing under considerable pressure, as was indicated by its agitation. At this time the elevation of the water in the reservoir was a foot or more below the crest of the spillway, and the entire discharge of the stream, amounting to approximately 5 cubic feet per second, was carried through the leak. There was also leakage through the earthen embankment at one end of the dam, and through expansion joints and cracks in the deck slab.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LATROBE WATER COMPANY.

A timber crib dam was constructed across Loyalhanna Creek by the Latrobe Water Company in 1895, for the purpose of forming an intake from which to pump water to the borough of Latrobe. It was about three miles northwest of Latrobe, at the village of Kingston, above which point the tributary drainage area is approximately 170 square miles.

The dam was constructed of hewn timber cribbing, spiked, bolted, and entirely filled with earth and rock. The downstream slope of the cribbing was 1 on 2, and the upstream side vertical, with earth placed against it to about its natural slope. The downstream side of the cribbing was faced with plank, and an apron, 10 feet wide, constructed along the toe throughout the length of the dam. The height of the structure, above the natural bed of the creek, was about six feet, and its total length on the crest 225 feet.

The dam was partly destroyed on two occasions, January 28th, 1904, and February 26th, 1912, Each failure was occasioned by high water, due partly to rainfall and melting snow, and partly from the breaking of ice jams upstream. The first of these floods carried out a 75 foot section at the southern end of the dam, entirely destroyed the cribbing, and deposited the rock some distance down stream. The washout section was replaced with the same type of structure as that of the remaining portion of the dam, and back-filled with earth.

The failure of the dam in 1912 occurred during a discharge of three feet of water over the crest, caused by the breaking up of two ice-jams above the dam. The cribbing was torn out and a breach washed through the structure in the section repaired in 1904.

LEBANON CITY DAM NO. 2.

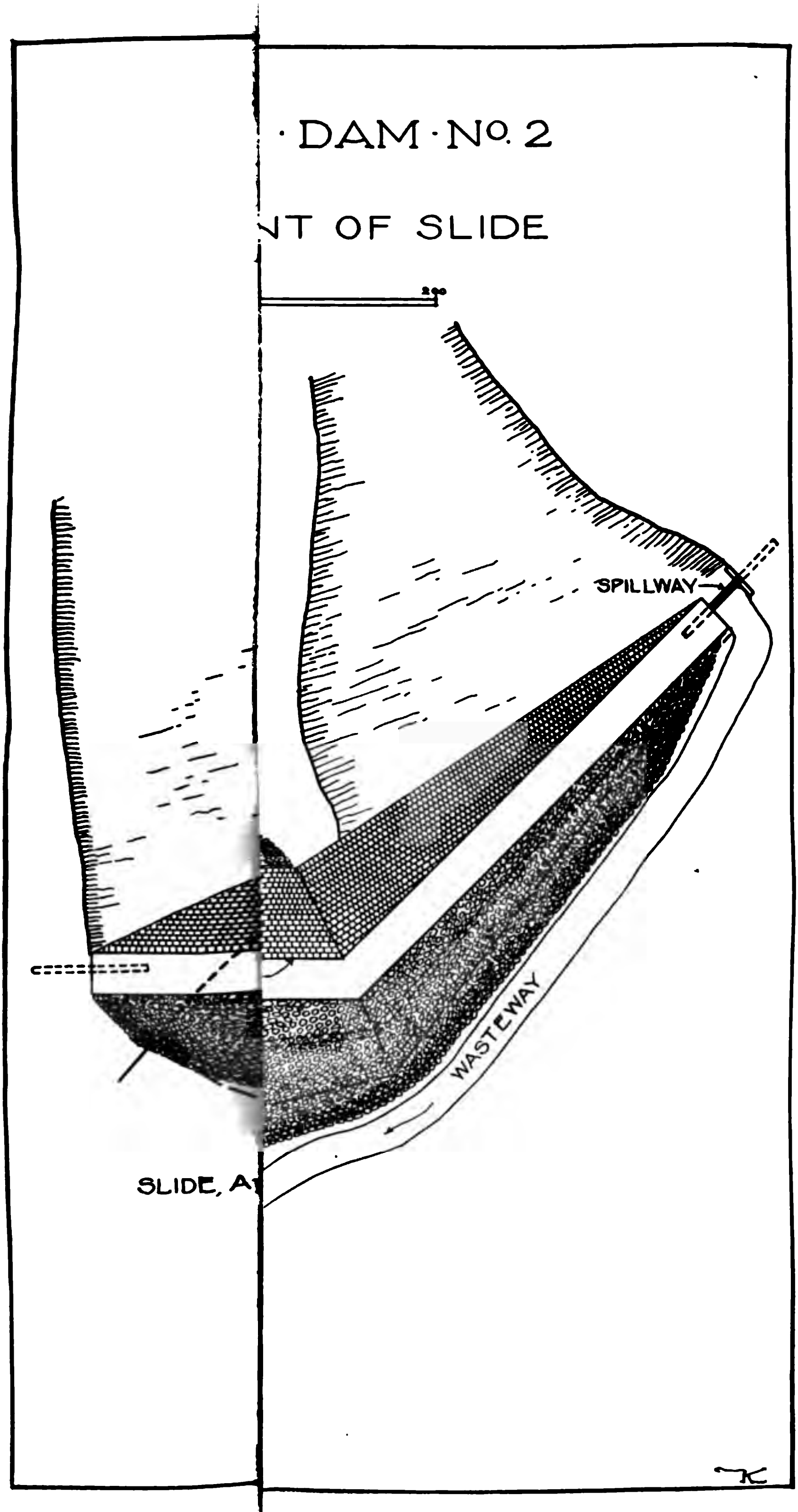
The No. 2 dam of the city of Lebanon, which was constructed in 1884, as a part of its waterworks system, is situated on the West Branch of Hammer Creek, at the foot of South Mountain, about six miles southeast of Lebanon, above which point the tributary drainage area is 317 acres. About 600 feet below this dam is another reservoir, known as No. 1, constructed in 1871, above which the drainage area is 317 acres. Reservoir No. 2 has a capacity of 49,200,000 gallons, and reservoir No. 1 a capacity of 18,000,000 gallons. The drainage area above these reservoirs is uninhabited mountain land and the runoff therefrom is said to be high. Below the No. 1 dam, at the foot of South Mountain, the country opens into a cultivated valley almost two miles wide; a low ridge to the north turning Hammer creek southward into Conestoga creek, and separating this drainage from the Quittapahilla watershed. In this broad, wide valley of the West Branch of Hammer Creek are a number of roads and farmhouses, none of the latter of which, however, lie directly below the reservoirs; and in the event of the failure of either of them it is probable that no lives and little property damage would result. Neither of these dams has failed, but the strength of dam No. 2 has been impaired on several occasions.

This dam consists of an earthen embankment which, as originally constructed, was about 22 feet in maximum height and 380 feet long. The width on top was 13 feet, while the upstream slope was 1 on 2½, and the downstream slope 1 on 1½. In 1909 the dam was raised to its present height, which is about 39 feet above the natural surface of the ground, and the total length was thus increased to 700 feet. In constructing the new embankment an 8 foot berm was made in the upstream face, at the elevation of the top of the old dam, and the new embankment was thence continued at a slope of 1 on 2. The crest width was made 15 feet and the downstream slope 1 on 1½. The embankment was constructed of material found in the reservoir bed, consisting of a mixture of sand, clay and shale, and the shrinkage in the embankment, due to packing and settlement, was stated to have been about 16 per cent. of the yardage measured in excavation. The upstream face of the old embankment was protected with vitrified brick, set on edge and filled with pitch, but the downstream face was not protected.

A gate-tower was built near the upstream toe of the dam, and from it 20 and 16-inch mains were carried through the embankment, while a 12-inch drain pipe was located about 80 feet to the west thereof. None of these pipe lines appear to have been provided with cut-offs or collars. A drain pipe was carried longitudinally through the lower portion of the embankment, from which several laterals led to the toe of the slope. At each end of the embankment cut off walls were carried 20 feet into the hillside, and the same distance into the embankment.

The spillway 15 feet wide and 1.7 feet deep is at the eastern end of the dam. The wasteway consists of a stone paved channel, carried along the downstream toe of the dam for a distance of about 240 feet, and into the old creek channel at a point about 80 feet below the same. The capacity of the old reservoir was 14,600,000 gallons, and by raising the embankment the storage was increased to 49,200,000 gallons. The capacity of the spillway is estimated at 100 second feet, and it provides for a runoff from the drainage area of one-half a square mile at the rate of about 200 second feet per square mile.

On April 4th, 1910, a slight slip occurred in the downstream portion of the embankment, and a more serious one on the following day, directly over the old 12-inch drain pipe, the total amount of the material moved being about 485 cubic yards. This material was thrown back to the 1½ to 1 slope, and the services of a consulting en-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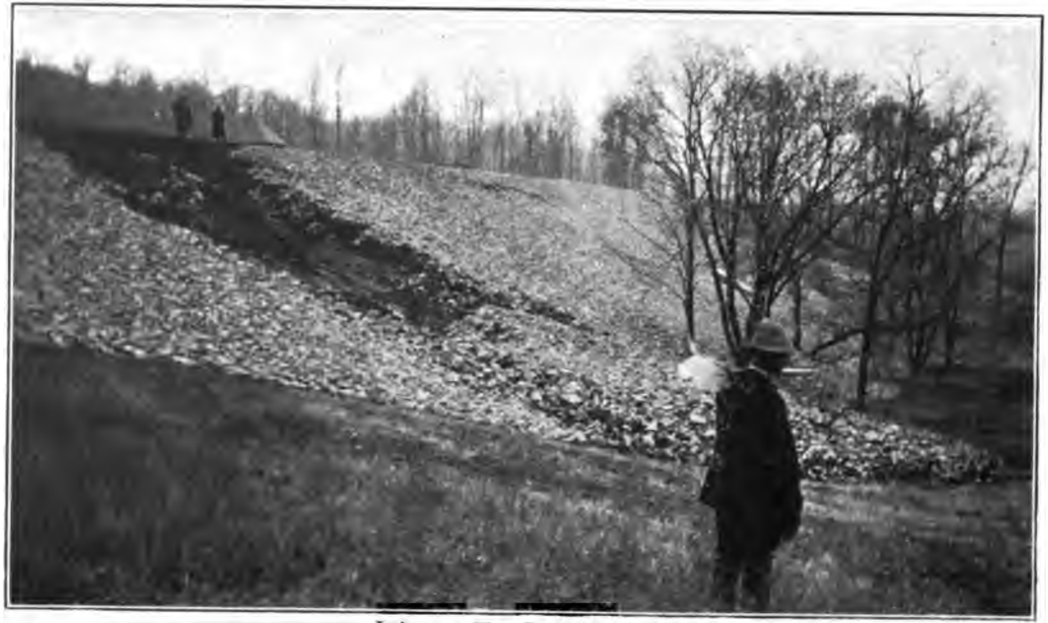
NT OF SLIDE
200
SPILLWAY
WASTEWAY
SLIDE, A



Lebanon City Dam—No. 2.

gineer secured for the purpose of recommending the method to be employed in the permanent repair of the dam, and to prevent the recurrence of the slipping of the downstream portion of the embankment. With regard to the slip in April, 1910, the following statement is contained in the report of the City Engineer, to the Board of Lighting and Water Commissioners of Lebanon:

"It was found that the stone paving on the top of the old breast forming the berm between the top of the old breast and the toe of the new breast had settled in several places, but the brick paving had remained intact and had not slipped down the slope. Therefore at several places there was an open space at the bottom of the brick paving. It was also found that the concrete which had been placed on the top of the berm had been frozen, and therefore was useless for the purpose intended. The stone paving was then torn up and relaid in concrete, and new material placed between the toe of the brick paving and the bottom of the concrete paving and over a foot of the brick work. The entire berm and about a foot down the slope of the old embankment was covered with concrete 4 inches thick." Besides this work, it is reported that all unfilled joints in the brickwork were poured with cement grout, and the entire paving slushed with a rich mixture of cement and sand. This cement covering cracked and peeled off soon after it was placed, and became useless in preventing percolation.

The dam was examined by a consulting engineer, who recommended that the downstream slope be made 1 on 2, and that the flattened slope should be secured by making a fill of stones and other loose material on the downstream side of the embankment. In May, 1911, the downstream slope was made 1 on 2; but it is understood the work was not done in the manner recommended by the consulting engineer, in that the additional slope was secured by filling with the same kind of material as was formerly used. This new slope was then protected from top to bottom with heavy hand-laid rock riprap.

On April 4th, 1912, a crack appeared at the downstream edge of the crest of the embankment, and it was noticed that the embankment had settled and bulged below the crack. On April 8th a large slip occurred about 120 feet from the west end of the dam, which extended over a length of about 65 feet. This slip started at the downstream edge of the crest of the embankment, and the material flowed for a distance of about 25 feet below the lower toe, leaving the riprap over the lower portion of this slope practically undisturbed. No breach was made through the dam, and no water passed out of the reservoir, but the water was immediately lowered three feet as a measure of precaution. The cause of this slipping of the embankment has not been definitely determined, but it will be observed that it occurred in the spring of the year when frost was coming out of the ground and during heavy rains. The material of which the embankment was constructed is of poor quality for such a purpose, and it is probable that the upstream facing is not impervious, and that there is percolation and seepage through the embankment, which contains no core or cut-off walls. Dependence was evidently placed upon the concrete and brick slope paving on the upstream face of the dam for watertightness, as the embankment is apparently pervious. With regard to the depth at which the embankment may have been saturated, the City Engineer stated in 1911, when it was decided to increase the outer slope of the dam from 1½ to 1 to 2 to 1, and soundings were made in the downstream portion of the fill, that the embankment was saturated to a depth averaging three feet vertically below the slope, and it appeared that sounding irons could be turned by hand without difficulty to this depth, while below it the material seemed to be hard and compact.

MACDONALDTON DAM.

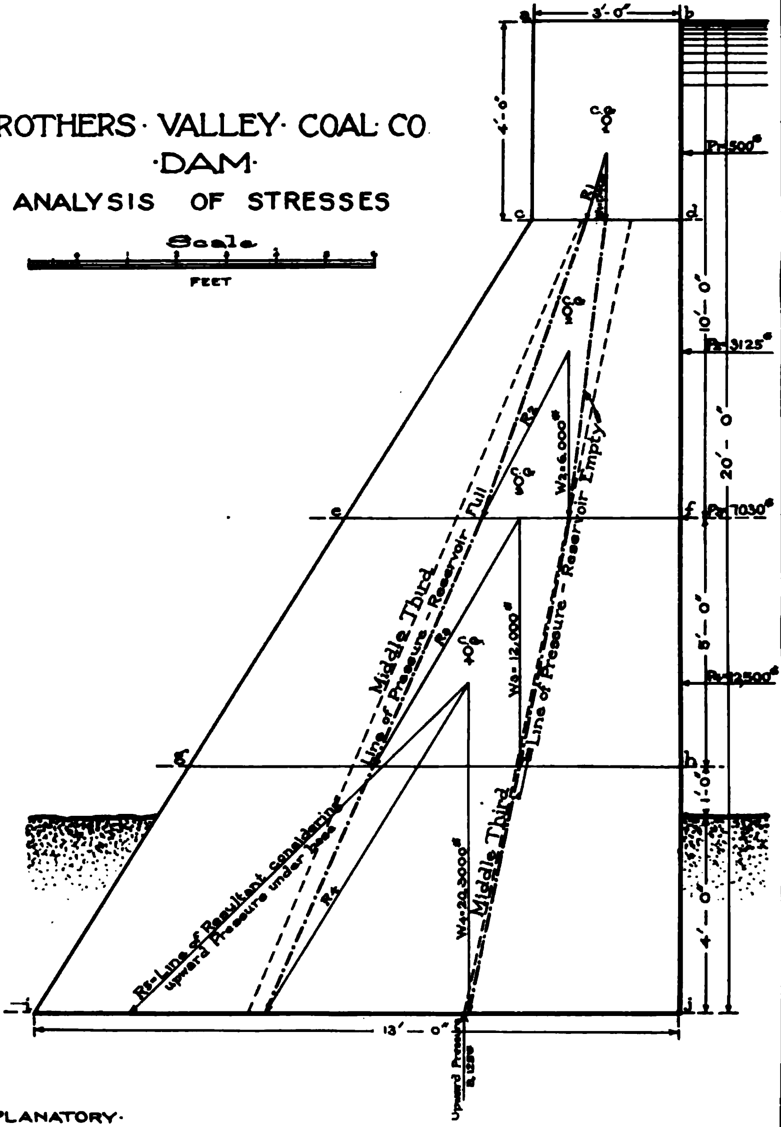
The Brothers Valley Coal Company completed, in August, 1911, a concrete dam across a small stream at the headwaters of Buffalo Creek, at Macdonaldton, Somerset County, for the purpose of impounding water for boiler use. The drainage area above the structure is 0.5 of a square mile, consisting of open, cultivated land. The reservoir, capacity about 16,000,000 gallons, was below the village, and the valley contained no houses which could be injured by a failure.

The dam, which was designed by engineers of the coal company, and built with company labor under the supervision of the designers, was constructed of concrete, with a vertical upstream face. The length on the crest was 419 feet, and maximum height above the ground surface 16 feet, while the foundation extended below the surface a distance of four feet. The top width of 3 feet remained the same to a point 4 feet below the crest, from which point the down stream face was battered, so that the width of the base was 13 feet.

The dam rested for two-thirds of its length upon a foundation of clay, and for the remaining third upon shale; and no precautions were taken to prevent the percolation of water beneath it, or to prevent sliding. The excess excavation in the trench was generally back-filled with the nearest material at hand,—clay, soil, or swamp muck,—and the puddle effect to be desired was not secured. Near the center of the dam was a spillway, 6 feet wide and 1 foot deep, while through the dam was a 16-inch waste pipe, and an 8-inch supply pipe, with valves near the downstream toe.

It is reported that from the time of completion, on August 1st, until September 14th, the water in the reservoir rose to within two feet of the crest of the spillway, at which time heavy rains caused

·BROTHERS· VALLEY· COAL· CO.
·DAM·
ANALYSIS OF STRESSES



EXPLANATORY·

WEIGHT OF MASONRY ASSUMED AT 145 LBS. PER. CUBIC FOOT. INTENSITY OF UPWARD PRESSURE UNDER BASE ASSUMED EQUAL TO FULL PRESSURE DUE TO HEAD AT UPSTREAM TOE AND DECREASING UNIFORMLY TO ZERO AT THE DOWNSTREAM TOE.

the reservoir to fill rapidly, until on September 15th, at 5 P. M., the water with within a few inches of the spillway crest. A slight crack was then noticed in the face of the dam, just below the top of the spillway, and by 6 P. M. this crack had become considerably larger and water was coming through it above the surface of the ground. Water was also observed bubbling up at the downstream toe, and at about 8 P. M. it had forced its way beneath the base by eroding an opening under the spillway section, about 25 feet long and 6 feet deep. The reservoir was completely emptied, but the flow was throttled and retarded so that no loss to life or serious property damage resulted.

Upon examination it was found that the center of the dam had moved downstream a distance of 8 inches, that there was a deflection upstream of 2½ inches at a point 123 feet from the west end, while the upstream face remained almost vertical, the maximum deflection being 1½ inches. The section undermined sagged about 3 inches, while several large vertical cracks extended entirely through the face of the dam.

An analysis of the probable stresses in the structure is given on Plate 19, having been computed on the assumption that the water pressure was effected between the crest and the foundation, with and without upward water pressure under the base. The intensity of the upward pressure was estimated as equal to the full hydrostatic pressure due to the head at the upstream toe, and decreasing uniformly to zero at the downstream toe. It will be seen from the diagram that, for reservoir empty, the line of pressure follows very closely the middle third, and the pressure on the base is well within safe limits. For reservoir full, with no upward water pressure on the base, the figure shows that the line of resistance lies well within the middle third, and that for this condition the dam was suitably designed against overturning, the factor of safety being 2.14 on the base. With regard to sliding, however, the analysis indicates that the coefficient of friction to prevent failure would have to be greater than 0.62, whereas it lies probably somewhere between 0.3 and 0.5, as the masonry rests upon a foundation of clay, probably more or less moist.

Upward water pressure probably did exist on the base of the dam, and, if the intensity was as indicated above, the line of resistance would cut the base "ij" at a point about midway between the middle third and downstream toe, or, more exactly, 2.4 feet outside of the middle third. For this condition, it is found that the tangent of the angle between the vertical and the resultant force acting on the base, which measures the tendency of the dam to slide, was 1.02. It would appear, therefore, that the dam was held in place largely by the material below the lower toe, and by tension in the masonry. On this assumption, also, the factor of safety against overturning is only 1.16; the diagram indicating that, as there could be no tension at the joint between the masonry and the clay, there was opportunity for the entrance of water under the base. The maximum compression on the base, at the lower toe, is 4,058 lbs. per square ft., or 28 lbs. per sq. inch, not an excessive figure.

The failure was due, it is believed, to percolation between the base of the dam and the foundation. With the increasing head, as the reservoir filled, the water forced itself under the dam and gradually washed out a channel, until, within a few hours, sufficient velocity was gained to cause the material to be forced out with a rush, leaving the dam suspended over the hole. There probably was also some sliding movement, and, had not the hole been washed out from underneath, the dam would evidently have failed by sliding.

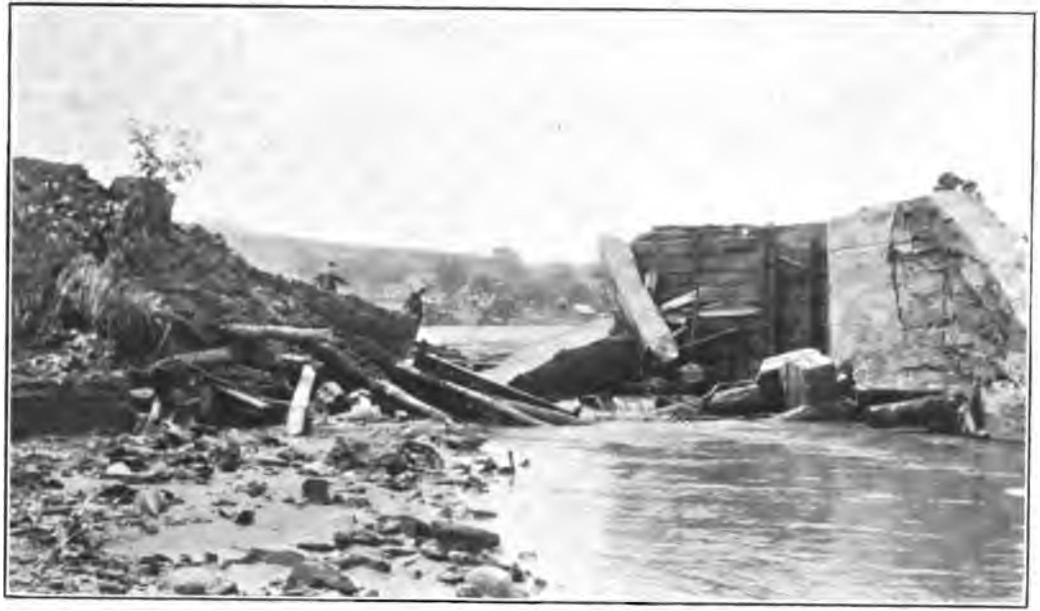
The dam was repaired shortly after the failure by filling the hole washed out from beneath with concrete, and placing a selected clay embankment on the upstream side of the masonry section, which was provided with drains, so that it could act as a gravity retaining wall. The reservoir has been in use since these repairs were made.

NORTH STRABANE WATER COMPANY DAM.

A timber crib dam was built across Little Chariters Creek by the North Strabane Water Company in 1901, and since its construction it has failed four times, twice in 1910 and twice in 1912. After the second failure in 1912 it was wisely abandoned, as it probably could not have withstood future floods unless entirely rebuilt on different lines.

The dam was about 12 feet high, 350 feet long on the crest, and when first built it was estimated to impound 20,000,000 gallons, but the basin soon became so silted up as to make the storage almost negligible. The cribbing was filled with rock and the up and downstream decks covered with plank; a clay fill was placed against the upstream side of the cribbing. At one end of the cribbing the dam was continued by means of an earth embankment, 40 feet long, to the hillside. The drainage area of Little Chartiers Creek tributary to the reservoir is 43 square miles, the dam being 1.5 miles above the mouth of the stream.

Of the failures in 1910 no accurate account could be secured; but the breaches, washed through the cribbing, were replaced by filling with clay, and in one portion with masonry. After the first failure in 1912, which occurred in about the center of the dam, a spillway was provided by means of constructing concrete wing-walls and filling the cribbing between them with rough masonry, cemented over the top. This portion of the spillway was built up to within about six feet of the top of the side walls, and flashboards were used



North Strabane Water Co. Dam.

to raise the water to the crest of the old remaining cribbing. This spillway was 49 feet in length and 6 feet deep, while on one side of it there remained a section of the old cribbing, about 60 feet long on the crest, and 2½ feet below the crest elevation of the spillway wall. On the opposite side of the spillway, the cribbing, or breaches which had been made in the same, had been covered with clay, and this embankment had a length on the crest of about 200 feet. A portion of the upstream side of this embankment was protected by means of a concrete wing-wall, 40 feet in length, attached to the spillway.

A heavy rainfuall occurred in the vicinity on July 24th, 1912, and the water rose behind the dam so that, at about 7 P. M., the spillway became filled and the water started flowing over the embankment. The water rose two feet over the crest of the dam by about 8 or 8.30 P. M., at which time a breach was washed through the embankment directly adjoining the spillway wall. The breach was about 30 feet in length and the full depth of the dam; the wing-wall connected with the spillway wall was demolished.

The spillway opening for a flood discharge, at the time of the failure, was 109 feet long and 2½ feet deep, and its carrying capacity was about 1,300 second feet. It was capable of discharging a flood run-off, therefore, at the rate of only about 30 second feet per square mile of tributary drainage area, and it is readily understood why it became filled and the embankment overtopped.

OAKFORD PARK DAM.

The failure of the Oakford Park Dam, on a small stream in Western Pennsylvania, which resulted in the loss of twenty-three lives, shows that a great catastrophe may be caused by the failure of a comparatively small dam, and accentuates the importance of supervision over such structures.

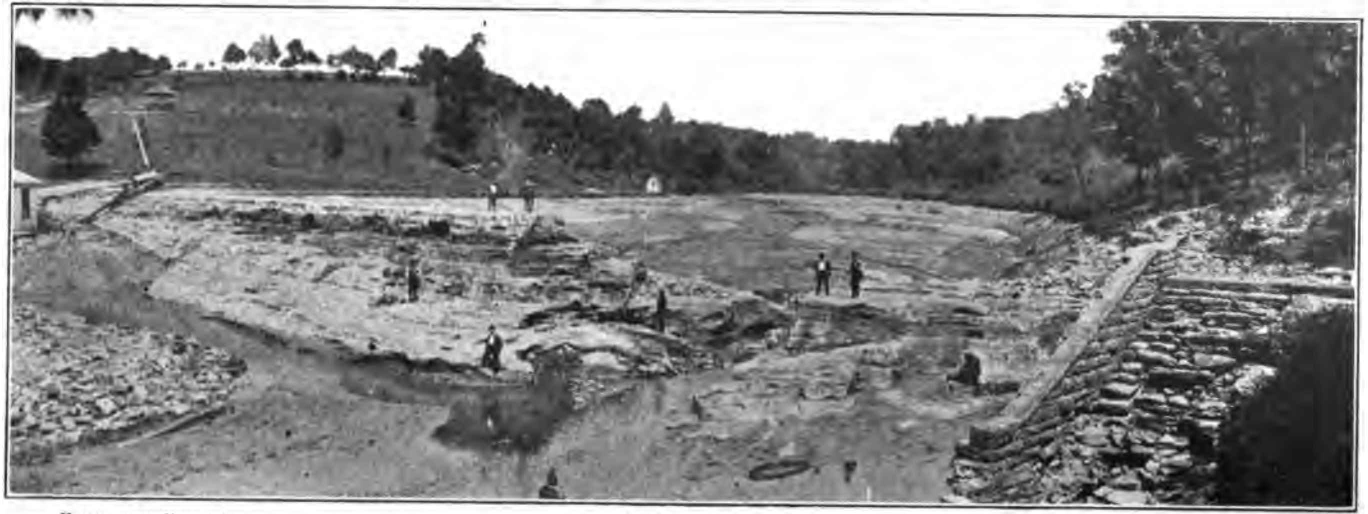
The structure was built by the Pittsburgh, McKeesport & Greensburg Traction Company in 1895, to form a pleasure lake in Oakford Park, which was maintained by the Traction Company. It was on Brush Creek, about a mile northeast of Jeannette, and the drainage area tributary to it consisted of 6 square miles of rolling farmland. The reservoir was about 1,000 feet long and covered an area of about 6 acres. Directly below the dam were a number of frame buildings, while about a mile below the structure the creek was carried in a culvert through the embankment of the Pennsylvania Railroad Company.

The dam was about 25 feet in maximum height, constructed of puddled earth, with a spillway at one end. It was 321 feet long and 14½ feet wide on the crest. Both slopes were 1 on 2, and were dry paved with flat stones, averaging 4 inches in thickness, 12 to

24 inches long, and 12 inches deep, laid on edge. The embankment is said to have been built in 8-inch layers of clayey loam, black soil, and gravel, and was hard and compact. There was no core-wall or puddle lining, although a rubble masonry wall of small stones, laid in cement mortar of poor quality, 2 feet thick, was constructed across the original creek channel, about 25 feet upstream from the center line of the dam. This wall was extended beneath the natural ground surface and into the embankment for a distance of 3 or 4 feet. The presence of many roots "in place," where the natural surface of the ground was exposed by the breach in the dam, indicated that the original surface was not stripped clean, if at all, in preparing the foundation for the embankment.

The spillway, 25 feet long, at the eastern end, was 3 feet below the crest of the embankment. A portion of this spillway had been quarried out of sandstone rock, while the remainder was formed by the embankment, which contained a masonry core-wall. The spillway was confined on the embankment side by a masonry abutment wall founded on rock, while the core-wall was extended from the abutment wall for a distance of 3 or 4 feet into the earthen embankment. The inner approach to the spillway, next the wall, was paved with stone, laid in cement mortar, the grade being 8 inches in 6 feet. The spillway crest was level, 3 feet wide, and formed of large cut stones. The waste-way was cut out of rock in 9-inch steps at the top, growing larger at the bottom; the average slope being about 45 degrees. The abutment wall was 2½ feet wide on top, increasing to 5 feet at 14.8 feet down, where it was spread to 11 feet in width. The capacity of the spillway is estimated at about 420 cubic feet per second, providing for a run-off in Brush Creek at the entirely inadequate rate of 70 cubic feet per second per square mile of tributary drainage area.

On July 5th, 1903, eight years subsequent to its construction, the dam failed by overtopping of the embankment. Previous to this date there had been heavy rains in Western Pennsylvania, so that the ground was saturated and conditions were favorable to excessive run-off. At about 4 o'clock in the afternoon of the 5th a heavy rainstorm occurred, described locally as a cloud-burst, and in a few hours, it is reported by a local observer, the rainfall amounted to 5⅛ inches. This resulted in excessive run-off, which could not be entirely carried by the spillway, and the embankment was soon overtopped. It is said that a watchman opened a 24-inch outlet pipe through the dam when the water began to flow over the crest of the embankment, and then warned the many visitors in the park of their danger and endeavored to make them leave. At about half past four o'clock the rainfall was exceptionally heavy and the dam was breached. The excellent quality of the embankment is indicated



From proceedings of
The Engineers Club of Philadelphia.

Oakford Park Dam.

by the fact that the breach was not washed through the structure until almost the entire downstream portion had been washed away, leaving an almost vertical face, which showed the successive layers employed in constructing the embankment. It is reported that the water rose to a height of between 2 and 3 feet above the crest of the embankment, and that complete failure did not occur until a considerable time had elapsed after the water began flowing over the earthwork, reported by one engineer who examined the structure as fully twenty minutes, and by another as about one hour.

The breach in the dam extended from the spillway abutment to a point 85 feet toward the western end. The maximum cut was 10 feet wide at the bottom and 35 feet at half the height of the embankment, and occurred directly over the old creek channel, while from this point to the spillway abutment a portion of the inner slope of the embankment remained. A rubble masonry cut-off wall, crossing the original creek channel, was breached so that the total depth of the opening was 25 feet. There was also a small break, about 8 feet wide and 4 feet deep, through the embankment at the western end thereof. The reservoir was completely emptied.

Assuming the depth of water on the crest of the dam to have been 3 feet, it has been determined that the maximum rate of run-off over the embankment and through the spillway amounted to 5,530 cubic feet per second; and as the drainage area was 6 square miles this would equal a run-off at the rate of 922 second feet per square mile. With 2 feet of water over the crest of the embankment the discharge would have been 3,270 cubic feet per second, or a run-off at the rate of 545 second feet per square mile of tributary drainage area.

The cause of the loss of life due to this failure is explained in two ways, both of which are here given, as it has been impossible to authenticate the information from either source. During the afternoon of the day of the failure there were many pleasure-seekers in the park, and when the heavy rain began many of them sought shelter in various buildings below the dam. One of these shelter houses was near the dam, and in the low part of the valley, almost directly below the breach which was later washed through the structure. It is probable that the people who congregated in this building would have had time to get out of the way of the flood had they realized the danger which menaced them; but it was raining hard, and they did not try to escape, even after the embankment had been overtopped. When the embankment failed the reservoir quickly emptied itself, and the water descended upon this building and destroyed it, causing the loss of 23 lives.

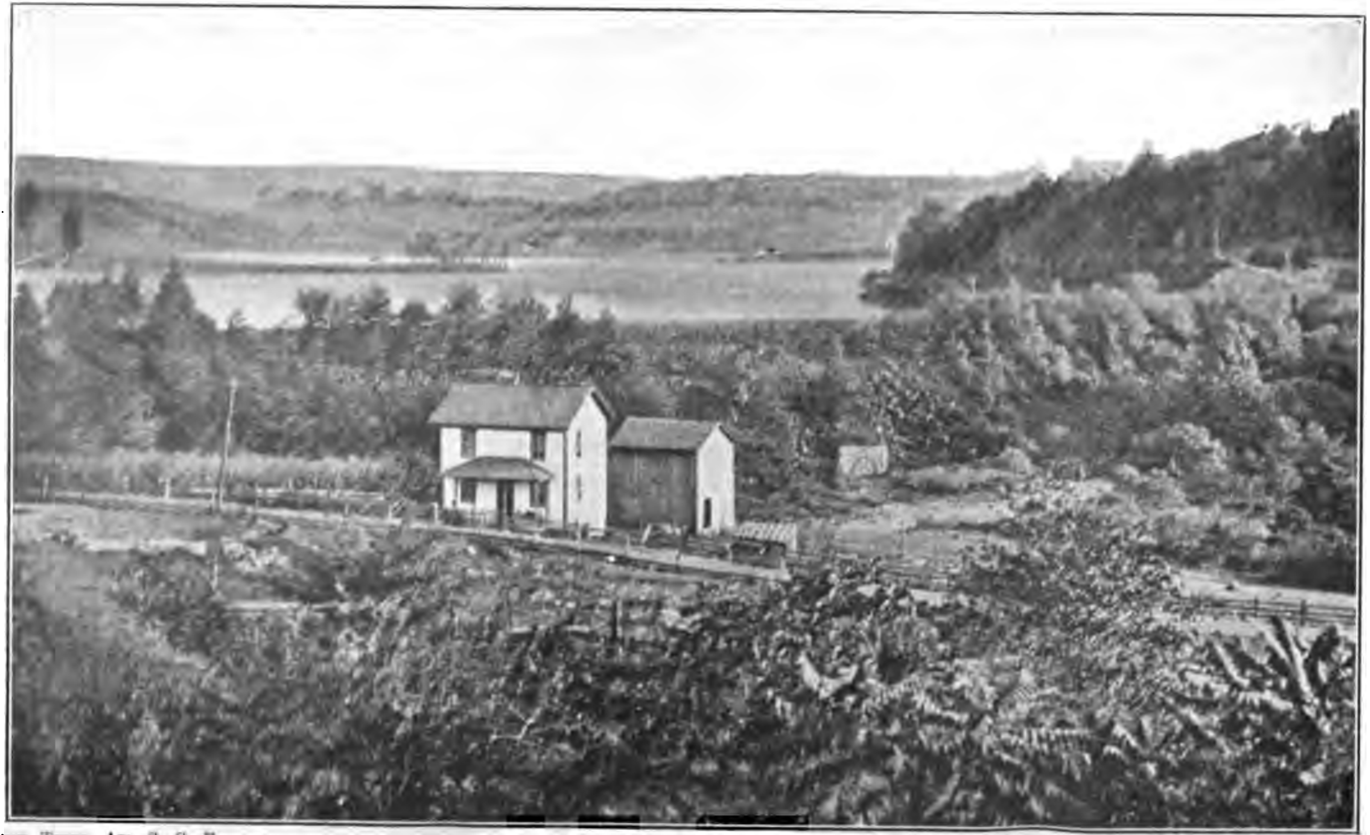
The second explanation of the manner in which the lives were lost is as follows: "The flood-wave rolling down the Brush Creek Valley after the dam gave way swept all the frame buildings in its path, overturned several trolley cars, and broke down a brick wall at the end of the car barn. One of the trolley cars, full of people, was standing on a small stringer bridge over Brush Creek at the car barn, 1,500 feet below the dam. The greatest loss of life was caused by the overturning of this car."

The flood continued down the valley to the culvert through the Pennsylvania Railroad embankment, which was about 16 feet high and of 22-ft. span. This culvert was partly obstructed by wreckage, and the water rose between 10 and 15 feet above its top, forming a pool probably 20 acres in extent, which lifted barns and houses from their foundations. Considerable damage was done to the railroad embankment, and 30 or 40 feet of the downstream end of the culvert was destroyed, leaving one of the railroad tracks suspended.

SOUTH FORK DAM.

The South Fork Dam was constructed early in 1853 by the State of Pennsylvania, for the purpose of forming a reservoir to feed the Pennsylvania Canal during dry seasons. The attention of the Legislature was called to the necessity of such a storage reservoir by the Canal Commissioners in 1834, and surveys were authorized for the purpose of determining upon a site for such regulating works. Mr. Sylvester Welsh, in November, 1835, recommended the construction of an 840-ft. dam, across the South Fork of the Little Conemaugh River, to form a reservoir to contain about 485,000,000 cubic feet. Later, after making further surveys and explorations, Mr. Welsh proposed a reservoir to cover 465 acres, with a capacity of 525,000,000 cubic feet, by the construction of a dam of a height believed to have been 72 feet. Mr. Welsh said: "It is proposed to build the dam of embankment and a wall of masonry in conformity to the plan heretofore submitted. The waste water should be carried through a channel around the end of the dam, and passed into the ravine below it. The bed of this channel would be of solid rock. No water should be permitted to pass over the dam. The sluices, through which the water would be drawn from the reservoir when required for use, should be made of cast iron, set in masonry."

The Legislature in July, 1839, appropriated $70,000 for the construction of the proposed South Fork and other reservoirs, and the work was placed under the supervision of William E. Morris, C. E. The Board reported on October 31st, 1839, that the necessary surveys had been completed, the location for the dam determined upon, and the work placed under contract. Mr. Morris approved of the location for the dam and reservoir as recommended by Mr. Welsh, and decided in favor of an earthen embankment, the original plan of which is on file in the Department of Internal Affairs at Harrisburg. The contract was awarded to James Morhead and



From Trans. Am. S. C. E.

South Fork Dam before Failure.

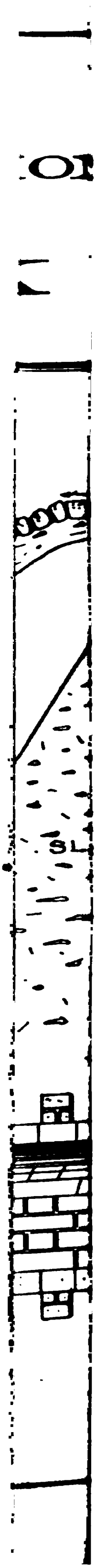
Company on November 6th, 1839, and David Watson was elected superintendent of the reservoir, the contract being dated, January 31st, 1840. The work was continued until May 1st, 1841, when it ceased because of lack of funds. On July 3rd, 1846, the Legislature appropriated $25,000.00 for the completion of the dam, and Mr. Morris prepared new plans and specifications, similar to his original ones with the exception that a frame tower was substituted for the masonry one; but work was postponed for one reason or another until 1851, when a new appropriation was made and the original contractors proceeded with the work. The dam was completed in 1853, the entire expenditure up to that time having been $166,647.50. During the year 1854 the Canal Commissioners reported two slight breaks in the dam, which were promptly repaired.

The reservoir was two miles above the confluence of the South Fork with the Little Conemaugh River, and about 16 miles above the city of Johnstown. The drainage area above the dam, found by an actual survey for the American Society of Civil Engineers, was 48.6 square miles, consisting of rough mountainous land, near the summit, on the western slope of the Allegheny Mountains. The shed comprises a broad, circular area about 8 miles in diameter, the stream dividing into several tributaries, chief of which are Laurel Yellow, and Beaver runs. The valley of the Little Conemaugh River below South Fork is steep and tortious, having an average descent in the 14 miles of 21.5 feet per mile. The stream is followed from South Fork to Johnstown by the main line of the Pennsylvania Railroad; the village of Mineral Point being three miles below South Fork, and the town of Conemaugh three miles above Johnstown.

The South Fork reservoir as constructed had a water surface, at the elevation of the spillway, of 407 acres, and a pool length of two miles. The section of the dam as indicated on the plan of William E. Morris in 1839, shown on Plate 23, indicates that the upstream portion was of good earth and puddle, the downstream portion of loose rock, and the central section of slate. The upstream slope was 1 on 2 and the downstream slope 1 on 1½, the former being covered with slate and stone riprap. The plan of the dam indicates that a culvert was carried through the embankment, in which were five lines of 24-inch cast-iron pipe, with a valve tower at the upstream toe of the embankment. The dam was about 900 feet long on the crest, 70 feet in maximum height, and had a wasteway excavated in the rock around one end. The embankment plan provided for a top width of 10 feet, and a maximum width on the base of 255 feet.

The reservoir was used by the Commonwealth as a feeder to the canal until July, 1857, when it and the canal were sold to the Pennsylvania Railroad Company. Subsequently leaks occurred in the embankment at the point at which the outlet pipes entered the culvelt, where, in July, 1862, a serious break occurred; the upper end of the culvert and a part of the embankment being washed out, although 20 feet of the lower end of the culvert and the embankment over it remained in place. The damage caused by the emptying of the reservoir, which was only partially filled, was slight, and the breach was not repaired by the railroad company; the western division of the canal, from Johnstown to Blairsville, being abandoned on May 1st, 1863. In March, 1875, the dam and reservoir were sold to Mr. John Reilly, and in June, 1880, came into the possession of the South Fork Hunting and Fishing Club of Pittsburgh. A few months previous to this the repair of the structure was begun, the work being let by contract to Col. B. F. Ruff. The following is an account of this repair work, as contained in the Report of the Committee of the American Society of Civil Engineers upon the cause of the failure of the South Fork Dam:

"The five lines of the 24-inch sluice pipes were taken out; the masonry on which they were laid and the remains of the culvert were left. A sheet-piling of plank was put across the lower part of the breach. The original plan of making the lower angle of the embankment of stone was adopted, and stone of as large size as could be obtained in the vicinity were dumped into the breach, letting them form natural slopes. This stone embankment was carried up until it reached such a height as to enable a road to be graded down from the remaining parts of the dam on each side of the breach, so that material could be hauled in carts from the borrow-pits on the hillside. There being no sluices for the discharge of the flow of the stream, the surplus water found its way through the stone embankment, the water in the reservoir rising as the filling on the upper side of the stone embankment proceeded. The washing of the filling through the stone embankment was prevented by covering its faces with brush, hay, etc. The material relied on to form the watertight embankment consisted of clay and shale, which was dumped in on the upper side of the stone embankment and carried up in layers to the full width of the remaining parts of the original dam. There was no systematic puddling done; but the hauling by teams over the freshly deposited material, which was kept wet by the rising water, made a fairly compact embankment on the upper side of the stone embankment. The work was not completed that season. During the following winter it was damaged by a flood, and the next year, 1881, the Hunting and Fishing Club completed it by day-work. The slopes on both side of the embankment were covered with a heavy riprap. According to Mr. Morris original plan and specifications the top of the dam was 10 feet wide and 10 feet above the ordinary surface of the water in the reservoir, which is understood to be nearly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the same as the floor of the waste-way. By our levels the floor of the waste-way, for 176 feet from the lake, averages 1602.82 feet above tidewater. The elevation at eight points on the top of the remaining parts of the dam, where not affected by the late washout, is 1610.78, being 7.96 feet above the floor of the waste-way, or 2.04 feet below its height as originally designed. This accords substantially with the statements of parties living in the vicinity, to the effect that, when the breach was repaired in 1880-81, the top of the dam was lowered about two feet, in order to make a more convenient roadway over it, the remains of which are now 15 to 20 feet wide."

Mr. Morris' specifications provided that the waste-way should have a length of 150 feet, its crest being 10 feet below the elevation of the top of the embankment. As actually built, however, the effective length of the spillway was less than 70 feet, the length at the entrance, where it was longest, being about 120 feet, and at the point at which the waste-way started to fall, 176 feet from the reservoir, it was 69 feet, which must be considered, therefore, as the effective length in determining its capacity.

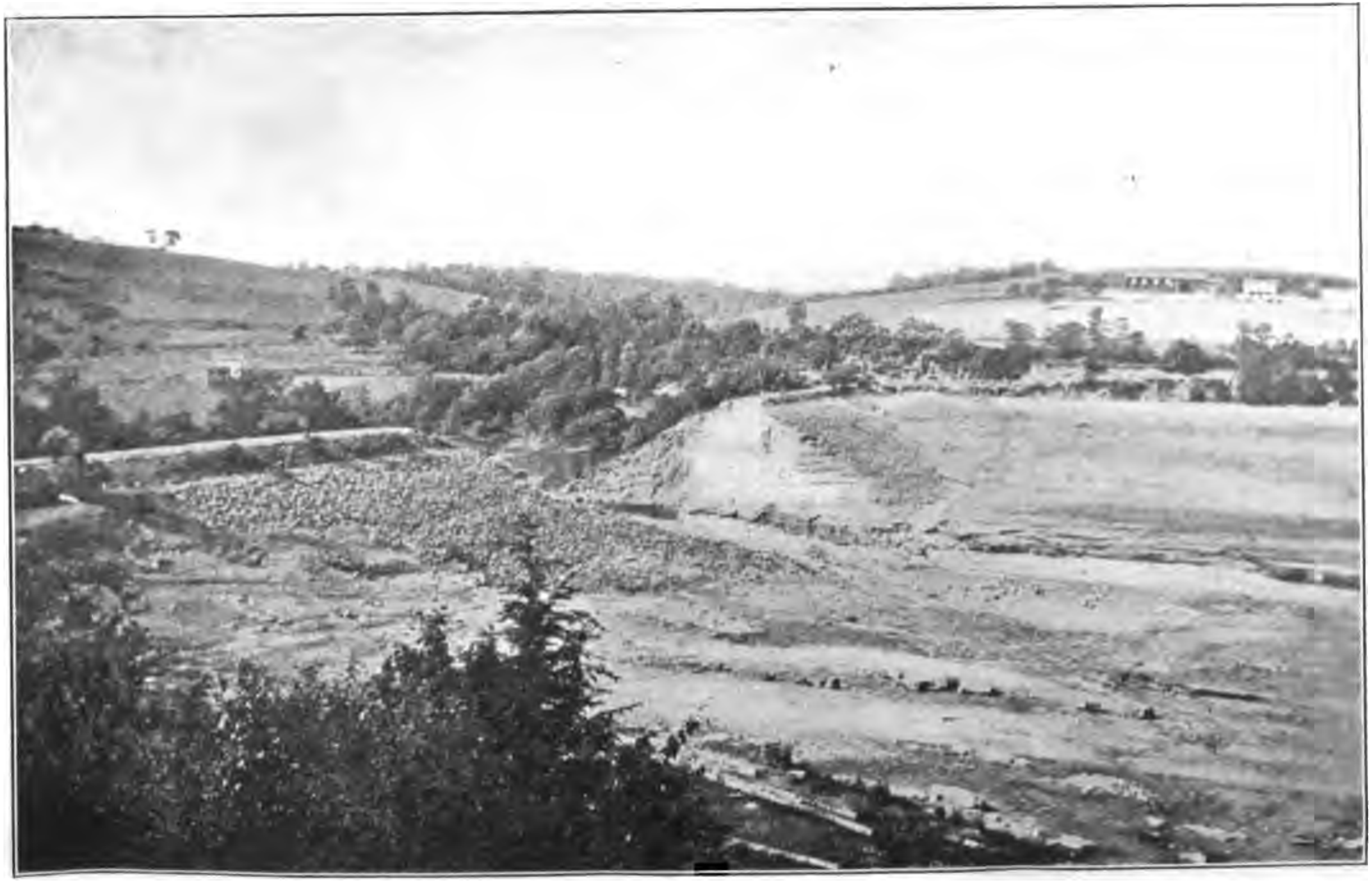
At the entrance to the spillway a wooden bridge was constructed across the same, for the purpose of carrying the road which followed the creek to South Fork. This bridge was 123 ft. 4 in. long, and was supported on wooden sills at both ends, and by a series of wooden trestles spaced 15 ft. 6 in. apart. The elevation of the top of the sill under the bridge in the waste-way, which was 99 feet in width, was 1603.4, and the elevation of the floor beam of the bridge was 1613.9, a difference in elevation therefore of 10.5 feet. The spaces between the trestles which supported the bridge were partly obstructed by fixed and movable fish-screens.

The historic failure of the dam occurred on May 31st, 1889, and was caused by water overflowing the top of the embankment, due to a flood in the stream, caused by the heavy rainstorm of May 30th and 31st, and to insufficient spillway capacity. The following is quoted from the Transactions of the American Society of Civil Engineers, with regard to this rainfall:

"On May 30 and 31 and June 1, 1889, there was a great rain on an area of about 20,000 square miles, mostly in Pennsylvania, but extending into Maryland, Virginia, and West Virginia. It is estimated that about three-fourths of this area, or 15,000 square miles, constituted the flooded area in Pennsylvania; the greatest amount of water appears to have fallen near the summit of the Allegheny Mountains and a little east of the same, where the rainfall was reported to have been 8 inches to 10 inches in 18 to 36 hours. Official records of the rainfall are reported from about 50 stations; but there is none from any point on the watershed of the South Fork reservoir, and it can only be inferred from observations reported from the watersheds in the vicinity..................The northeast and southeast quarters include parts of the summits of the Alleghenies and of their eastern slopes. The easterly boundary of the South Fork watershed is this summit, and by inspection of the table and the accompanying map, we infer that the rainfall on this watershed was from 6 to 8 inches. As we are informed, the heaviest part of the rain was during the night of May 30 and 31, during which time it appears that there must have been several hours when it fell at a rate of not less than two-thirds of an inch an hour on this watershed."

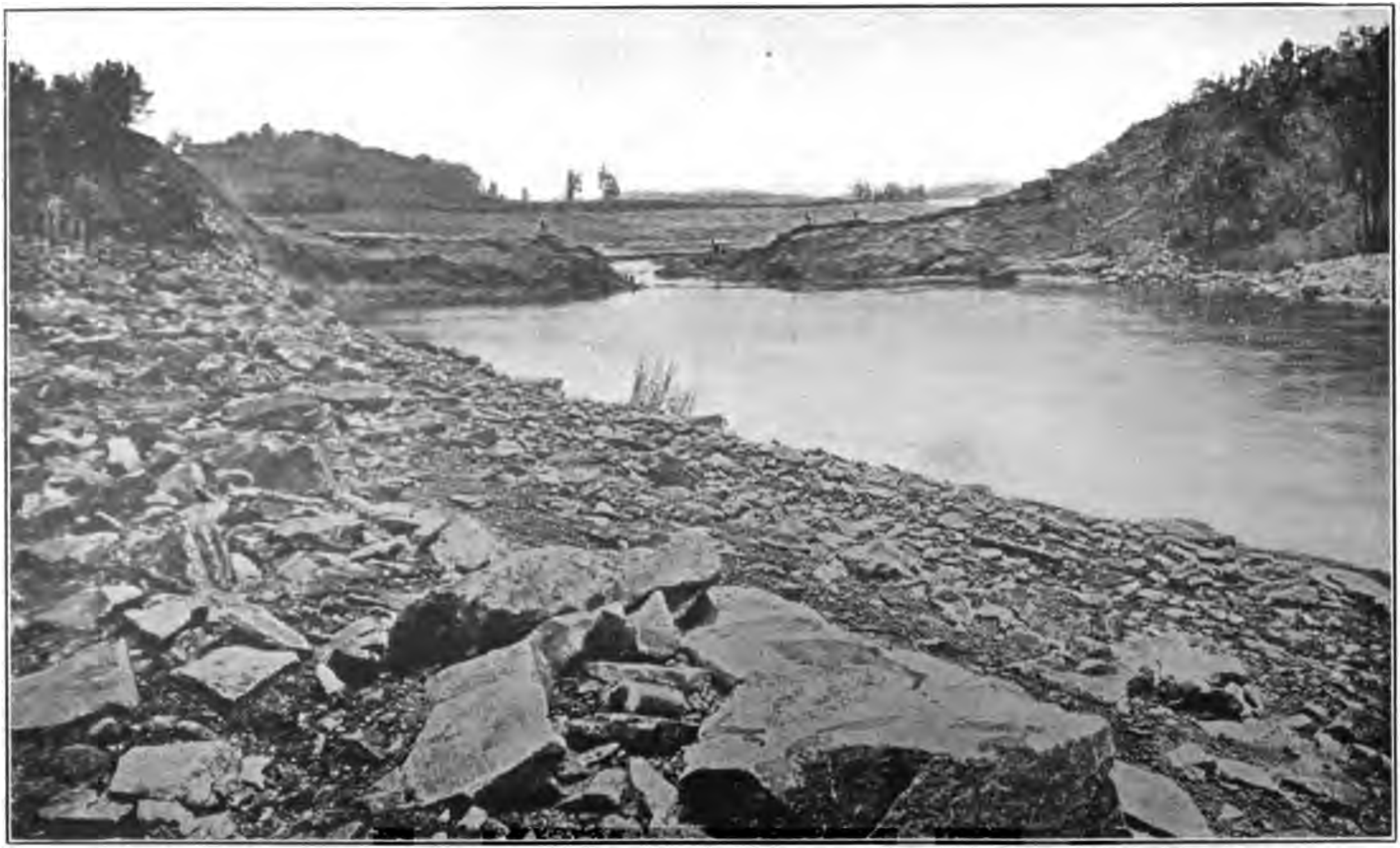
An account of the failure of the dam is contained in the Transactions of the American Society of Civil Engineers, as observed by Mr. John G. Parke, Jr., a civil engineer, who was an eye-witness and who wrote the following letter to the President of the American Society:

"We rowed to the club-house and found the water had risen at a wonderful rate during our row to the top of the lake. I had been thinking of the dam, and was not surprised when landing to be told that the water was nearly over the dam and that men and a plow were needed there. So taking a horse from the stable, I rode to the breast and found Colonel Unger, President of the South Fork Fishing and Hunting Club at work on the dam with a number of Italian laborers (that we had employed on some sewerage work); there were about 16 of them. Half of them were cutting a ditch around the shale rock at one end of the breast. This ditch was cut through the original ground and about 25 feet from the constructed portion of the breast. The shale was so tough that they could not cut it more than about 14 inches deep and about 2 feet wide, but, when it was cut through to the lake, the water rushed in and soon made it a swift stream, 25 feet wide and about 20 inches deep; but the rock was so hard that it could not cut it any larger than this. Previous to this being opened and shortly afterward, I made two observations of the height of the water, and the lake in the hour had risen 9 inches. During the digging of this ditch I rode back and forth over the dam directing the laborers. We had a plow at work throwing up a furrow, and thus raising a temporary barrier or breast to retard the water flowing over the dam, should it reach that height, which it was gradually doing. I noticed that the waste-wier proper was discharging to its full capacity, and that there was no drift or other matter to clog it, except a road bridge supported on small posts which were apparently offering but little resistance as the wier was narrower by about 15 feet at 100 feet from its mouth, and this contraction compensated for the resistance to flow offered by the bridge supports. There was probably seven feet of water in the wier at the time. There were some iron screens between the foot of each post on the outer row of the bridge supports, but they were



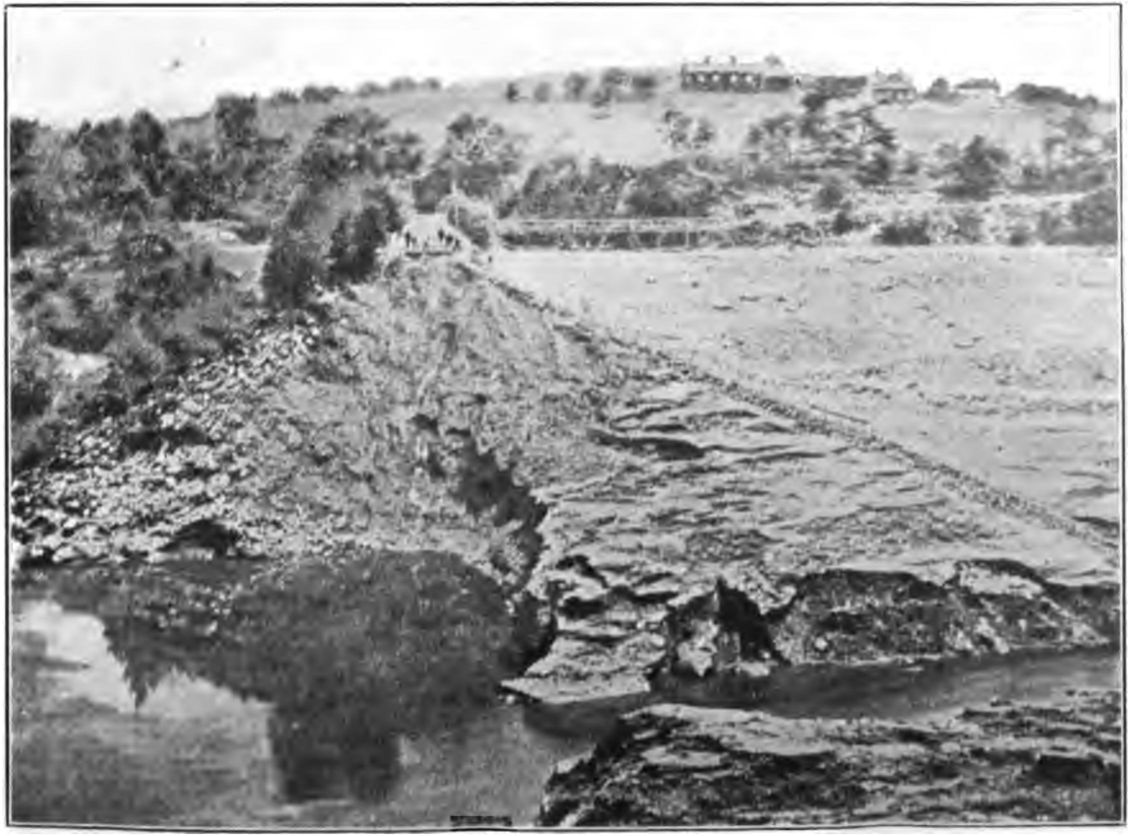
From. Trans. Am. S. C. E.

General View of South Fork Dam after Failure.

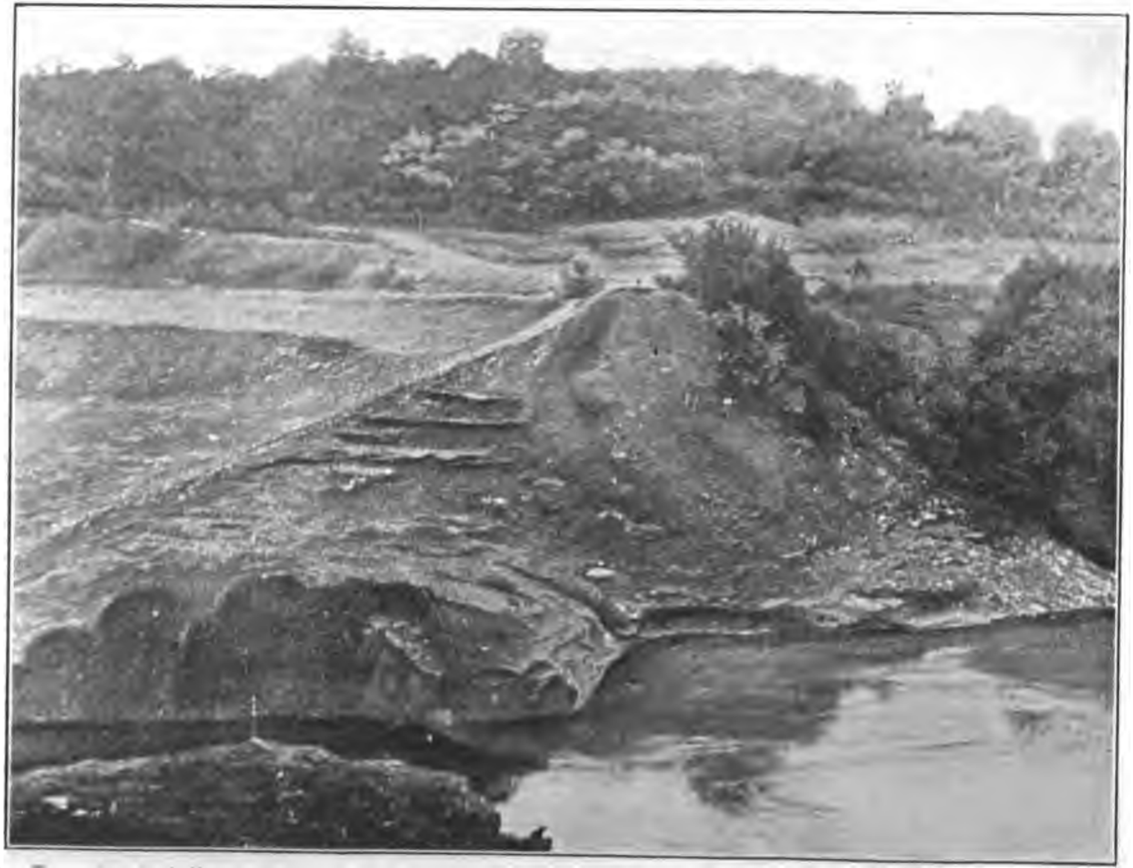


From. Trans. Am. S. C. E.

Distant View of Broken South Fork Dam, Looking South, and Showing Stones Left on the Sides of the Valley by the Flood.

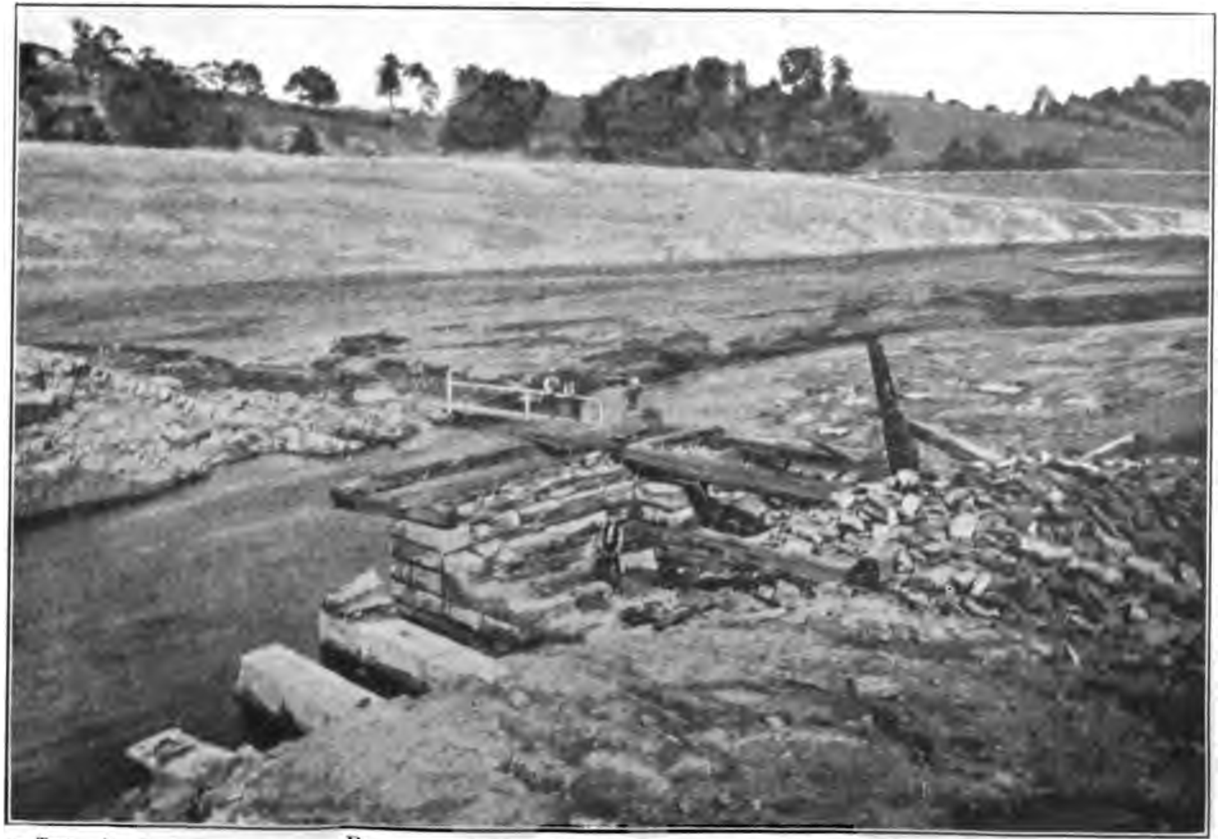


From. Trans. Am. S. C. E. The Break in the South Fork Dam, Looking East.

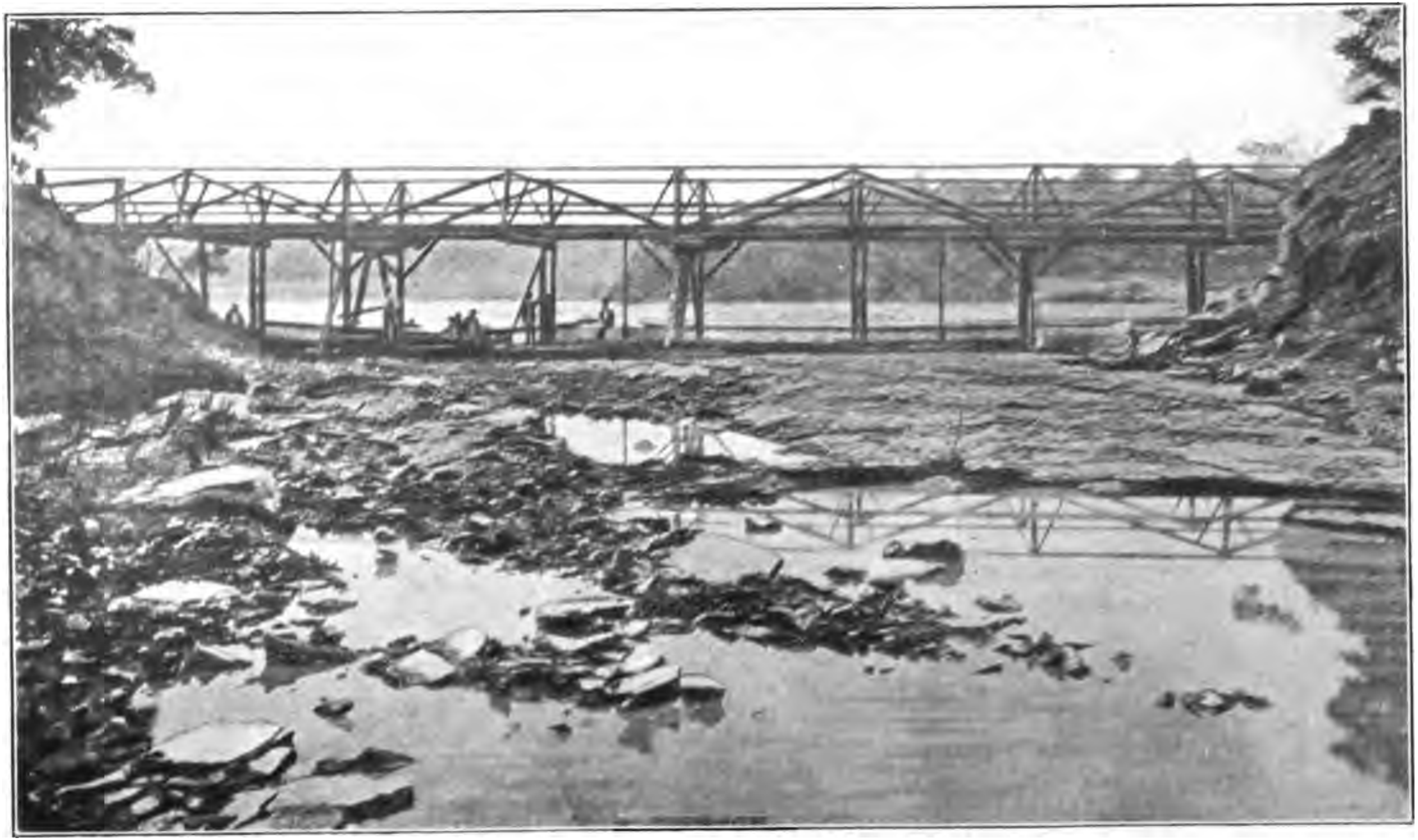


From Trans. Am. S. C. E.

The Break in the South Fork Dam, Looking West.



From Trans. Am. S. C. E. Remnants of Gate Chamber in South Fork Dam.



From. Trans. Am. S. C. E.

South Fork Dam.
View taken from a Point in the Water-Way, Showing Bridge and Fish Screens.

but 18 inches high and could not have been removed, had we wished to, owing to the depth and velocity of the water. The water in the lake rose until it was passing over the breast, notwithstanding that the lake had then the two outlets (the waste wier and the one cut by the laborers). The breast was slightly lowered in the center and the water washed away our temporary embankment thrown up by the plow and shovels, and the water was passing over in many places in a distance of 300 feet about the center of the breast; the men stuck to their task and worked until the water was passing over in nearly one sheet, and then they became frightened and got off the breast. I saw what would be the consequence when the water passed over the breast and rode to South Fork village and warned the people in the low lands there, and had word telegraphed to Johnstown that the dam was in danger. The people in South Fork heeded the warning and moved out of their houses. When I left South Fork, to return, it was just 12 o'clock noon, and the water had been flowing over the dam for at least a half hour. I rode back up to the lake, 2½ miles through the valley, and found the men had torn up a portion of the flooring of the waste-wier bridge and were endeavoring to remove the "V" shaped floating drift guard that projected into the lake. It was a light affair and was built to float on the surface of the lake and catch twigs, leaves, etc., and prevent their clogging up the iron screenes spoken of above. I crossed the breast at this time, and found the water was cutting the outer face of the dam, but not as badly as I feared it would; its greatest effect was on some portions of the roadway which crossed the breast where the roadway had been widened on the lower side by the addition of a shale earth or disintegrated shale, upon which the action of the water was instantaneous, but the heavy riprapping on the outer face of the dam protected this wash and the water cut little gullies between each of the large stones for riprap. I did not stay on the dam when it was in that condition, but went on to the end of the dam, and found that over its entire top it was serried by little streams where the water had broken through our little embankment and was running over the dam. I went on to the new waste-wier we had cut and found it carrying off a great volume of water and at a great velocity. I with difficulty waded it and found that it was up to my knees, or 20 inches deep. I felt confident that nothing more could be done to save the dam unless we were to cut a wasteway through the dam proper at one end and allow it to cut away in but one direction, and that towards the center of the dam; but this I would not dare to do, for it meant the positive destruction of the dam, and the water at the time was almost at a stand, owing, without doubt, to the large increase of outlet by the overflow on the breast, and I hoped that it would not rise, but yet expected it to rise, for it had been raining most all of the morning, and consequently we had more water to expect. I hurried to the club-house to get my dinner and to note the height of the water in the lake, and found that it was a little over a stake, that from my level notes of a sewer I was constructing I knew was 7.4 feet above the natural lake level. I returnd to the dam and found the water on the breast had washed away several large stones on the outer face, and had cut a hole about 10 feet wide on the outer face and about 4 feet deep; the water running into this hole cut away the breast in the form of a step both horizontally and vertically, and this action went on widening and deepening this hole until it was worn so near to the body of the water in the lake that the pressure of the water broke through; and then the water rushed through this trough, and cut its way rapidly into the dam at each side and the bottom, and this continued until the lake was drained. I do not know the actual time it consumed in passing through the breach, but it was fully 45 minutes. It did not take long from the time that the water broke into this trough until there was a perfect torrent of water rushing through the breast, carrying everything before it; trees growing on the outer face of the dam were carried away like straws. The water rushed out so rapidly that there was a depression of at least 10 feet in the surface of the water flowing out, on a line with the inner face of the breast and sloping back to the level of the lake about 150 feet from breast, exactly similar to water flowing through a rectangular sluice-way in the side of a trough with the water level far above the bottom of the sluice-way. When the lake was drained there still remained in the bed of it a violent mountain stream 4 or 5 feet deep, with a swift current, the combination of the two streams already alluded to from the head of the lake and the many litle streams from the adjacent hills, which streams were all overflowing their banks; this stream in the bed of the lake showed no signs of diminishing in volume until late in the following day, and was impassable with a boat for several days.

"I need say nothing of the character of the dam, for it is open for inspection of those far more able to express an opinion than I. But there is one thing I want to impress on every one's mind, and that is, that the dam did not break, but was washed by the water passing over it from 11.30 o'clock A. M. until nearly 3 P. M., until the dam was made so thin at one point that it could not withstand the pressure of the water behind it, and, the water once rushing through this trough, nothing could withstand it."

The following description of the breach washed in the embankment it contained in the Transactions of the American Society of Civil Engineers:

"The breach in the embankment is about 24 feet wide at the top and 50 to 200 feet wide at the bottom, the amount of earth and stone in the same being about 90,000 cubic yards. All the material put in in 1880-81 to repair the breach of 1862 appears to have been washed out, together with a part of the old embankment made in 1851-52. Some parts of this old work are exposed by the flood and indicate that it offered great resistance to washing, and that it was originally selected and put in with the requisite care to make a sound embankment. The original construction of the embankment, as indicated by the plan and specifications, and more particularly the mode of repairing the breach, may be objected to as not being according to the best practice; nevertheless, the failure of the dam cannot be attributed to any defect in its construction. The failure was due to the flow of the water over the top of the earthen embankment, caused by the inefficiency of the wasteway to discharge the flood water."

The Committee which examined the South Fork dam after its failure went to considerable trouble in attempting to determine the maximum rate of run-off in the South Fork of the Little Conemaugh River at the dam site, the conclusion reached being that this maximum flow occured at about 4 P. M. on May 31st, and amounted to about 10,000 cubic feet per second. This would equal a run-off at the rate of 206 second feet per square mile from the tributary drainage area of 48.6 square miles. With regard to the capacity of the wasteway, the report of the Committee on the South Fork Dam states: "Assuming the maximum flow into the reservoir to have been 10,000 cubic feet pèr second, and the waste-way to have been constructed according to Mr. Morris' specifications, with the other outlet at the entrance, we estimate that the corresponding height in the reservoir would have been 7.80 feet above the crest of the waste-way, or 2.20 feet below the top of the embankment, as specified by him. With the five lines of 24-inch sluice pipes discharging to their full capacity at the same time under 70 feet head, as no doubt was originally designed to be done in an emergency, we estimate the height in the reservoir to be 7.52 feet or 2.48 feet below the top of the embankment. The height of the embankment as constructed in 1851-53 was according to Mr. Morris' plan and specifications. According to our method of estimating the flow through the waste-way the discharge through it, when free from obstruction, and the water in the reservoir just up to the top of the embankment as originally constructed, and the sluice pipes discharging to their full capacity would be 6923 cu. ft. per second. For the waste-way and sluices as constructed in 1851-53 to discharge 7980 cu. ft. per second, which we have estimated above to have been the flow into the reservoir at the time of the breach, the height in the reservoir under the same conditions would be 10.95 feet above the floor of the waste-way, or about 1 foot above the top of the embankment as originally constructed. For the discharge of the maximum quantity entering the reservoir, which we think was not less than 10,000 cu. ft. per second, under the same conditions would require a depth of about 10.63 feet.................

....

In concluding, we must state that, while our deductions are based on our observations of rainfall and of flow, which are necessarily approximate, we feel satisfied that they are not far from the truth. There can be no question that such a rainfall had not taken place since the construction of the dam. But the surface of the watershed is quite steep, and the consequent rapid discharge of a large percentage of the rainfall into the reservoir would require a very large outlet to prevent a dangerous accumulation. The spillway, however, had not a sufficient discharging capacity; contrary to the original specifications of Mr. W. E. Morris, requiring a width of overflow of 150 feet and a depth of 10 feet below crest, which would have been a sufficient size for the flood in the present case, it had only an effective width of 70 feet, and a depth of about 8 feet; the accumulated water rose to such a height as to overflow the crest of the dam and caused it to collapse by washing it down from the top. The dam itself, or the parts of it which were left standing, showed undoubtedly that it was well and thoroughly built, and that it would have successfully resisted the pressure of the water. The exposed sides of the breaks show distinctly that the compact layers of which the structure was formed were not obliterated by the wearing action of the flood, and they stand conspicuous witnesses of the value of an earth embankment, when well built of good materials, to impound large bodies of water."

The flood in the Conemaugh Valley caused by the rain of May 30th and 31st, and by the failure of the South Fork Dam, caused a loss of life estimated by the Secretary of the Flood Relief Commission on June 30th, 1890, to have been 2,142, while the property loss was estimated at between $3,000,000 and $4,000,000. Before the failure of the dam a portion of the city of Johnstown was already inundated to an unprecedented extent, the water being 10 feet deep in some of the streets, preventing many people from escaping from their homes, when the flood caused by the failure of the dam reached the city. The mass of debris carried by the flood, consisting of houses, bridges and other wreckage, lodged against the railroad stone-arch bridge at the lower end of the city, forming a barrier, which still further raised the water and floated other buildings from their foundations; much of this wreckage later burned. The loss of life and property was the most disastrous ever recorded from the failure of a dam. The structure has never been repaired or rebuilt.

APPENDIX A

PYMATUNING RESERVOIR REPORT

Water Supply Commission

OF

Pennsylvania

1912

Shenango River below Turnerville Bridge and Dam Site.

REPORT

OF THE

Water Supply Commission of Pennsylvania

ON THE

Feasibility of Constructing a Storage Reservoir in Pymatuning Swamp, Crawford County, Pennsylvania

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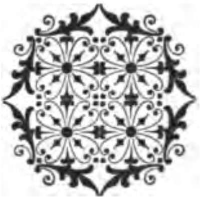

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REPORT
# of the
WATER SUPPLY COMMISSION OF PENNSYLVANIA
UPON
THE FEASIBILITY OF CONSTRUCTING A STORAGE RESERVOIR
in
PYMATUNING SWAMP
CRAWFORD CO., PA.

Office of the Water Supply Commission of Pennsylvania,
Harrisburg, Penna., December 31st, 1912.

To the Members of the Senate and the House of Representatives, of the Commonwealth of Pennsylvania:

In compliance with the provisions of the Act of the General Assembly, approved the 14th day of June, 1911, the Water Supply Commission of Pennsylvania respectfully submits its report upon the feasibility of constructing a storage reservoir in Pymatuning Swamp, Crawford County, Pa., and its influence in regulating the flow of the Shenango and Beaver rivers.

The Commission has made a thorough topographical survey of the swamp, and surrounding area, plotted the same on a scale of 300 feet to the inch, with 2 feet contour intervals, carefully investigated the proposed dam and reservoir site, examined conditions along the Shenango and Beaver rivers below said swamp, studied the hydrographic features by means of precipitation and stream discharge records and measurements, has prepared preliminary plans of the proposed work, has estimated the cost of the project, and has determined that the construction of a storage reservoir is feasible.

PYMATUNING SWAMP.

Pymatuning Swamp is an extensive morass covering 10,400 acres in southwestern Crawford County, at the headwaters of the Shenango river, near the summit of the divide between the Ohio river and Lake Erie drainage, its elevation being approvimately 1,000 feet above sea level. The land immediately adjoining the morass is periodically overflowed and is used chiefly for pasture, while that beyond and above the swamp level is devoted to agriculture. The greater portion of the swamp proper is densely overgrown with timber or brush, while much of the bordering land is forest covered. The population in the proposed reservoir area is about 250, equivalent to 10 persons per square mile. Six square miles of a total of 24.7 which would be overflowed lies in the State of Ohio.

PREVIOUS LEGISLATION.

The Pymatuning Swamp has been the subject of considerable legislation, principally with relation to the drainage thereof, and as early as February 28th, 1868, a resolution was passed by the Legislature providing for "a survey and estimate of expense of reclaiming certain bodies of land in the county of Crawford, known as the Conneaut and Pymatuning Marshes, and a report, with plans and estimates, of the practicability and expense of the same, to the next Legislature." This survey was made by Col. James Worrall, a civil engineer, who reported favorably, on January 28th, 1869. Nothing was done, however, as the result of this report.

The Legislature of 1907 passed an Act, on June 13th, 1907, by which $10,000 was appropriated to the State Highway Department with which to make surveys of Pymatuning Swamp and determine upon the "best course and method of making channels for draining the same and improving the highways therein, to advertise for proposals and let contracts for making such channels and draining said swamp" * * * "provided, however, that the plans shall be approved by the Water Commission." It further provided that no portion of this appropriation should become available "until the citizens of said county (Crawford) shall have raised a like amount for the improvement of the highways."

The county having failed to raise the money required by the Act, and no steps having been taken by the Highway Department to put the same into effect the 1909 Legislature repealed the provision requiring the raising in the county of an equivalent sum to that appropriated.

Following the passage of this repealer the Highway Department proceeded to make surveys, and to prepare plans and estimates, and in June, 1909, submitted its plan for the proposed drainage of the swamp to the Water Supply Commission. The Commission made an examination of the swamp and held hearings at which a number of protests were made against the proposed drainage, on the ground that the swamp was a valuable storage area and helped to maintain the dry weather flow of the Shenango river. The hearing disclosed that there is a large consumption of water from this stream, and an insufficient flow therein. It also indicated the possible injurious effect, on the communities down the river, which might result from the drainage of the swamp, and, at the same time, the possible advantages of converting the swamp into an artificial storage reservoir for increasing the dry weather flow. As a result of its investigation the Commission refused to approved the plans as submitted.

ACT OF 1911.

The Legislature of 1911 passed an Act, June 14th, appropriating $10,000 to the Water Supply Commission, with instructions to examine into the feasibility of the reservoir project and to report to the Legislature of 1913, accompanying such report with plans and estimates of cost. The Act above referred to is as follows:

AN ACT

Providing for a survey of Pymatuning Swamp, and an examination into the feasibility of constructing a reservoir therein to conserve the waters draining into said swamp, and making an appropriation therefore.

Section 1. Be it enacted, etc., That the Water Supply Commission of Pennsylvania is hereby directed to survey the Pymatuning Swamp, in Crawford County, Pennsylvania, and lands contiguous or adjacent thereto, and to examine into the feasibility of constructing a dam or dams across the outlet or outlets of said swamp, whereby the waters entering the same may be conserved, to regulate the flow of water in the Shenango and Beaver rivers. The said Commission shall prepare maps, plans and estimates, and report in writing to the Legislature of one thousand nine hundred and thirteen, giving the results of such survey and examination, and such additional information and recommendations as the Commission shall deem proper.

Section 2. That the sum of Ten Thousand Dollars ($10,000) or so much thereof as may be necessary be and the same is hereby specifically appropriated to the Water Supply Commission of Pennsylvania, for the purpose of carrying into effect the provisions of this Act.

APPROVED the 14th day of June, A. D. 1911—John K. Tener.

EXISTING CONDITIONS.

1. The present flow of the Shenango and Beaver rivers at numerous points, particularly Sharpsville, Sharon, Farrell, and New Castle, is insufficient to adequately supply the needs of these communities and their growth has been, and will continue to be, seriously hampered unless a sufficient water supply is made available. The minimum stream flow at Sharon and New Castle is approximately 20 and 25 cubic feet

per second, respectively, while the total demand of all the communities and works using the stream is approximately 356 cubic feet per second.

2. Damage by floods at several points along the river has been serious, notably at Sharon and New Castle, while agricultural lowlands along the entire stream, as well as railroads, highways and bridges, have been injured or destroyed.

3. The sanitary condition of the channel, where the river passes through the larger communities is deplorable, due to the inability of the stream at low water to properly carry off and dilute the sewage, manufacturing refuse, garbage and other waste deposited therein.

4. The Shenango river is little used for water power development. In its original condition, before its shores were traversed by railroads, and its low water flow depleted, it was a good stream for such purposes, but at present it is of small value. On the lower Beaver river the fall has been utilized by water power plants which have depreciated in value, condition and output, owing to the low flow of the stream in summer.

5. The temperature of the water during dry periods, owing to industrial use, become so high as to reduce its efficiency for cooling purposes, for which the stream is now largely utilized, resulting in a decreased flow due to augmented evaporation.

RESULTS OBTAINABLE.

1. Investigation determined that a portion of Pymatuning Swamp and adjacent area can be converted into a storage reservoir by constructing an earthen dam, having an average height of 27 feet, across the valley of the Shenango river near Turnerville, approximately three miles north of the Crawford-Mercer county line, and that other portions of the swamp may be advantageously drained.

2. Such dam, with an approximate length of 2,910 feet, could be provided with a concrete spillway founded on rock, having its crest at elevation 1,008 feet above sea level, the top of the dam being 10 feet higher. It would overflow, at spillway level, 24.7 square miles, or 15,800 acres, and impound 8,182,000,000 cubic feet, or 61,204,000,000 gallons.

3. By drawing this reservoir down 4.3 feet in the average year, and 9 feet in the dryest year, which would have occurred once in the past 35 years, the low water flow of the Shenango river at Sharon, can be so increased that its minimum discharge will be 450 cubic feet per second, or 290,700,000 gallons per day, while under present conditions the extreme minimum flow is 20 second feet, or 12,900,000 gallons. This increased low water flow would be ample to supply the present demands of the users of the Shenango and Beaver rivers, and would provide for future growth.

4. The proposed reservoir would eliminate any considerable contribution to floods from the 150 square miles of territory tributary above the dam, which constitutes one-quarter of the area above Sharon and 18.7 per cent. of the area at New Castle.

5. The proposed reservoir would improve the sanitary and asthetic condition of the Shenango and Beaver rivers, and of the Pymatuning Swamp.

6. It would add approximately 2,000 primary horsepower to the existing water power development on the Beaver river between Beaver Falls and the mouth, where the stream is partially utilized, but which, because of the low summer flow is now of little value in such periods, and it would improve the few small water powers of the Shenango river in operation above that point.

7. A regulated flowof 450 second feet would confine the temperature of the river water to small variations instead of permitting of a rise in temperature to 140 degrees F. (which it has been frequently known to reach), and would eliminate the large evaporation losses now occurring from the overheated stream.

8. The amount of cultivated land required for the proposed reservoir is 2,413 acres, of which 448 acres is reclaimed swamp used for onion culture. There remains at the upper end of the reservoir, and above the proposed water surface, 1,482 acres of swamp land easily reclaimable for similar cultivation and of equally suitable character and accessibility. The farm land which would surround the reservoir should be increased in productivity by reason of the rise in the ground water level.

9. The cost of the entire project, including the acquisition and preparation of the reservoir area, and buildings thereon, relocation of roads, bridges and railroads, and construction of dam and regulating appliances, is estimated at approximately $1,600,000.

10. The Commission is of the opinion that the construction of this dam and reservoir would cause a benefit along the Shenango and Beaver valleys, more than commensurate with the anticipated cost of the project, and that the industrial development would be increased, and also that the communities in the vicinity of the reservoir would be benefitted through improved highways, the creation of an attractive lake, water transportation, and better sanitary conditions.

PURPOSE OF INVESTIGATION.

Under the instructions given by this Act, the Commission has proceeded to examine into "the feasibility of constructing a dam or dams across the outlet or outlets of said swamp, whereby the waters entering the same may be conserved, to regulate the flow of water in the Shenango and Beaver rivers." It was necessary to determine the need for regulating the flow of these rivers, the amount of regulation required, the amount of storage capacity which could be obtained, the yield of the watershed, the amount and character of land and the number of buildings which would be submerged and the roads and railroads to be relocated, the nature of foundation for dam sites and the probable cost of the project, as well as the effect of the proposed reservoir upon the surrounding country.

It was also necessary to examine into the feasibility of, and the advantages to be obtained by, draining the swamp land, keeping in mind the proposed use of this area as a storage basin for supplying the summit level of the proposed Lake Erie and Ohio River Ship Canal.

METHODS EMPLOYED FOR INVESTIGATION.

Following the passage of the Act of June 14th, 1911, existing data was collected and studied and an engineering corps organized. The general direction of the work and the organization of the field corps was placed in the hands of the Engineer of the Commission, Farley Gannett, and the responsibility of collecting data and general charge of the field work was given to E. E. Haslam, who was experienced in this class of work. The field force began surveying the reservoir site in January, 1912, and completed the same in August.

A triangulation system was established and check levels were run over the territory to be included in the reservoir survey, following which a stadia survey was made, covering about thirty square miles. This survey was plotted on twelve sheets, to a scale of 300 feet to the inch, with two-foot contour intervals, a special sheet on a scale of 100 feet to the inch being made of the region surrounding the dam site. Considerable areas of the swamp had never been surveyed, being, ordinarily practically impenetrable. but, owing to the intensity cold winter of 1912, these areas were solidly frozen and were traversed.

Rain gages, installed on the watershed at Linesville and Turnerville, were read regularly while the force was in the field and have since been maintained. Experiments were also made to determine the probable evaporation from the water surface of the reservoir if built, three experimental evaporation tanks having been erected at Linesville and in the swamp.

Stream gaging stations were established at Linesville, Pollock's Bridge, Turnerville and Greenville, on the Shenango river below the swamp, at which points the daily flow was determined, while at the stream gaging station, established in 1909 at Sharon meter measurements were made during flood and low water stages to perfect this record.

Ground water conditions were studied by means of the periodic examination of forty-six drilled and dug wells in and around the swamp.

An estimate of the value and cost of removal of the standing timber in the area to be submerged was made by the Forestry Commission, and a valuable report thereon was received from that department.

In arriving at the proper volume of regulated minimum flow in the Shenango river at Sharon, as large an amount was provided for as was possible without causing excessive fluctuations in the reservoir, or flooding a large percentage of cultivated land. The available precipitation and run-off would permit of river regulation at Sharon on the basis of a minimum flow of 500 cubic feet per second, but a minimum of 400 second feet is sufficient for present demands, and, if the project is built in the near future, that amount would probably be all that it would be necessary to maintain at Sharon, and the reservoir fluctuation would be reduced. On account of the fact that at Sharon, the point for which the regulation was designed, the drainage area is four times that at the dam site, the resulting regulation will not be complete, but only occasionally will water be wasted over the dam. The reservoir will fill every spring and reach, as a rule, its greatest depletion in the late fall or early winter. To elevate the dam and flood a larger area would make the project unnecessary expensive, but if the demands on the stream increase so that more water is necessary, it may then be profitably obtained in that way.

The level of the spillway, and hence the level of the water surface with the reservoir full, was based upon the available run-off, the area to be flooded and the requisite storage capacity. The capacity of the reservoir at various levels was plotted and the elevation selected which would give, with moderate fluctuation, the greatest capacity, the best regulation and flood the smallest amount of valuable land. This spillway elevation was determined to be 1,008 above sea level, and the top of the dam was placed ten feet higher.

A study was made to determine the effect of the reservoir in retarding floods, by which it was found that, on account of its great area, the reservoir could retain the greatest floods, even when it was full, and practically eliminate the floods flows from this portion of the watershed.

Samples of the soil, at various points in and around the swamp, were analyzed by, and valuable information obtained from, the Pennsylvania State College authorities, to determine the agricultural values of the various portions of the area to be flooded and of the lands which would border on the proposed reservoir.

Borings were made across the site selected as the most feasible of the several dam sites considered, samples being taken every five feet, and preserved for study and record. On the west side these borings reached rock, and on the east side and in the bottom land the borings went to a depth of fifty to sixty feet without finding rock.

Property lines within and bordering the area to be flooded were located, and the nature of the ground, whether swamp, timber, pasture or cultivated land noted. The assessed valuation of the property and buildings involved was determined from the assessors' books and a ratio of assessed valuation to market value obtained.

To determine the average, maximum and minimum precipitations. and to estimate from these the run-off from the area above the dam site, previous to the installation of the stream flow gages, rainfall records of all adjacent points in Pennsylvania and Ohio were tabulated from 1878 to date.

From the river discharge record at Sharon, the ratio of run-off to rainfall for each month was established for 1909, 10, 11 and 12, and the variation of run-off to rainfall in each month, based on actual flow determined. The run-off by months from 1878 to date, indicate two periods of deficiency, one from 1893 to 1898 and the other from 1903 to 1912; which, when studied in detail showed the greatest deficiency in the latter period, and all subsequent computations were based upon this.

From the results of evaporation experiments, from June to October, 1912, inclusive, the annual loss from the water surface of the proposed reservoir was estimated. As shown by the Greenville records, this was an average year of climatological conditions and the evaporation determined was assumed to be the mean annual for this district, amounting to 30.9 inches per year from the proposed reservoir surface. The run-off records indicate a mean loss of 21 inches from the ground surface, leaving ten inches excess evaporation from the water surface.

The variations in the level of the reservoir surface that would have occurred at the end of each month from 1904 to date were calculated, using as a basis a draft sufficient to maintain a minimum flow at Sharon of 450 cubic feet per second. Information as to the fluctuation of Conneaut, Chautauqua and other lakes nearby, or similarly located, was obtained and the variation of the proposed Pymatuning reservoir in the average year was found to be no greater than the extreme fluctuation of some other large lakes notable as summer and health resorts.

Several miles of highways and a portion of the Pennsylvania Railroad between Linesville and Espyville, would be submerged by such a reservoir as proposed and it would become necessary to relocate or elevate them. In determining upon the proper roads to be provided across and around the reservoir, the State Highway Department was consulted.

A comprehensive study was made of the lower Shenango and Beaver rivers, elevations of normal, low and high water being determined at numerous points, in order that an accurate profile of the river from the proposed dam site to the Ohio river could be plotted. Flood damage was recorded where it could be obtained, the consumption of water by water companies, municipal water works, industrial plants, railroads, etc., was ascertained and the equipment and condition of water power installations were noted.

WATER STORAGE.

Water storage for river regulation has not been applied in Pennsylvania, but it has been practiced for years in other states and abroad. In Maine, rivers are regulated for the benefit of water power and lumbering, large storage being obtained at relatively low cost by raising existing lakes. In New York extensive reservoirs have been, and are being, built to regulate streams for feeding the Erie Barge Canal, while some smaller storage was created several years ago in the Adirondack region for water power improvement. That state has within recent years made surveys to determine the feasibility of extensive storage for river regulation in the interest of state development of water power and navigation. The United States Government has affected storage on the headwaters of the Mississippi by raising lakes and flooding swamps for the benefit of navigation. Colorado and other western states have built reservoirs for stream regulation and for irrigation purposes and the Federal Reclamation Service has built and is erecting large storage with a similar object.

In Ohio, funds have been raised at Youngstown for the regulation of the flow of the Mahoning river, in order to maintain a sufficient water supply for that community for domestic and industrial use. The proposed reservoir will have a capacity of 1,270 million cubic feet, utilizing the water from a catchment area of 283 square miles.

Abroad certain German states have built storage reservoirs for flood control and drought relief, while the Belgian and French Governments have done similar work.

In Pennsylvania, reservoirs have been constructed by corporations for domestic and industrial water supply, but the project considered in this report is the first proposed for river regulation with the exception of reservoirs built for supplying the old Pennsylvania Canal, that built by the City of Harrisburg in 1910 to regulate the flow of Paxton creek and those proposed by the Flood Commission of Pittsburgh, for flood control above Pittsburgh.

As the demand for water increases with population and industry, and as the stream flow, due to natural causes, continues to reach lower proportions, the necessity for the regulation of the flow of streams by artificial means increases. In the Shenango Valley, the status of industrial development is such that without largely augmented water supply, further increase in population and industry must be slow, and in the near future must cease. The State has wisely aided in the solution of this problem by providing the funds for a careful investigation of the feasibility of constructing the Pymatuning reservoir, and as a result of this study, the Commission is assured of the desirability of its construction, and the feasibility thereof, the resulting benefits accruing to the State at large, as well as to the various communities along the stream.

COST OF STORAGE..

The estimated cost of the Pymatuning project is $1,600,000 for which expenditure 8,182 million cubic feet of water will be held in a reservoir, of which volume it is proposed that 5,060 million cubic feet, or 60 per cent. will be available for use, the balance to remain in the reservoir to keep the swamp inundated. It is only occasionally that a reservoir of any considerable extent is designed to be completely emptied and the unused capacity may be considered as a factor of safety as well as a sanitary measure.

The cost per cubic foot of storage varies inversely with the proportions of the project, large reservoirs usually costing less per million cubic feet than small ones. The purpose to which the reservoir is to be devoted, also affects the design, and the cost; reservoirs for domestic water supply requiring costly preparation of the entire submerged area, expensive controlling apparatus, etc. The least expensive storage is effected by raising existing lakes, or by submerging flat land of little value; and some of the United States Reclamation Service reservoirs have been cheapened because the value of the land, being a part of the public domain is not considered.

The expense of storage varies widely, as is illustrated by a comparison of the estimated unit cost of the Pymatuning project with other reservoirs which have been built or proposed. The storage in this reservoir is estimated to cost $191.00 per million cubic feet, or $25.60 per million gallons, over 40 per cent. of the outlay being represented by value of land and buildings required. The following tables show the location, capacity and cost of some other reservoirs for domestic water supply, or for river regulation, fairly comparable in size to the proposed Pymatuning reservoir.

TABLE NO. 1.
Cost of Reservoirs For Domestic Water Supply.

Name.	Capacity in million Cu. Ft.	Cost per million Cu. Ft.	Remarks.
Wauchusett, Mass.,	8400	$269 60	Masonry dam and earth dykes.
New Croton, N. Y.,	4300	970 30	Concrete dam.
Ashokan, N. Y.,	17000	785 00	Estimated—Concrete dam.

TABLE NO. 2.

Cost of Reservoirs For River Regulation.

Name.	Capacity in million cu. ft.	Cost per million cu. ft.	Remarks.
Youngstown, Ohio,	1270	$790 00	Estimated.
Pittsburg Flood Commission, Pa.,	Average of 17 reservoirs, total capacity 60 billion cu. ft.	360 00	Estimated.
Delta, N. Y.,	2675	336 50	
Hunent Valley, California,	6100	229 16	
*Reservoirs for regulating Upper Mississippi River.		15 00	By raising existing lakes and swamps.
*Buena Vista, California,	7150	20 20	
*Indian River, N. Y.,	4475	18 70	

*Value of land flooded not included.

These figures are sufficient to show that the proposed reservoir is neither an expensive nor a particularly cheap one, but that its cost is reasonable for the locality in which it is to be situated, when the proximity of the great industrial centers which it will benefit is considered. The most inexpensive projects are usually located far distant from inhabited localities.

CONSTRUCTION AND OPERATION.

The Commission is of the opinion that if the Pymatuning reservoir is built, those interests which are directly benefitted should bear their proportions of the expense. There are numerous prosperous cities and boroughs, three counties with large resources, many extensive industrial corporations, public service companies and water power users, all of which, it is believed, should share in the cost of building and maintaining this projected reservoir, while the State should have supervision over its construction, and operation.

COST AND GENERAL FEATURES.

The following tables give a brief summary of the estimated first cost of this project, and the cost of operation and salient facts concerning the reservoir. The structural features would cost about 54 per cent. of the entire outlay, and the acquisition and preparation of the reservoir area, about 46 per cent. The operating expense is approximately $100,000 per year for thirty years, after which the sinking fund and interest payments would cease, and the annual charge would be approximately $13,500.

TABLE NO. 3.

Preliminary Estimate of Pymatuning Reservoir.
Estimate of Cost.

Item.	Description.	Amount.	Totals.
A	Earthen dam,	$336,422	
B	Spillway and regulating works,	150,730	
C	Highway and railroad changes,	352,050	
	Total for dam, highways and railroad,		$839,202
D	Reservoir site:		
	Clearing reservoir site and improving shores,	59,500	
	Land and buildings,	657,700	717,200
	Total estimated cost,	....	$1,556,402

ANNUAL FIXED CHARGES FOR OPERATION AND MAINTENANCE.

Total cost of dam, reservoir, land and buildings, clearing of woods and shore treatment, rebuilding and relocating roads, railroads and bridges,	$1,556 400
Annual interest on this at 4 per cent.,	62,256
Annual payment to thirty year sinking fund, earning 4 per cent.,	26,680
Taxes, or equivalent payment in lieu of taxable property vacated in townships, 1 per cent. on $254,000,	2,540
Repairs and depreciation on perishable parts of dam and regulation works, 5 per cent. on $100,000,	5,000
Operation—one superintendent, 3 assistants, including petty supplies and incidentals,	6,000
Yearly fixed charges,	$102,476
At end of 30 years,	$13,540

TABLE NO. 4.

General Information Concerning the Proposed Dam and Reservoir.

Description.	Amounts.
Elevation of top of dam above sea level,	1018 feet
Elevation of flow line above sea level,	1008 feet
Elevation of water surface at maximum draft,	999 feet
Maximum height of dam as per preliminary design,	46 feet
Average height of dam as per preliminary design,	27 feet
Maximum depth of water at dam,	36 feet
Length of concrete spillway,	250 feet
Length of earthen dam on crest,	2910 feet
Area of reservoir at flow line,	24.7 sq. miles
Approximate length of full reservoir,	16 miles
Average width of full reservoir,	1.54 miles
Maximum width of full reservoir,	2.56 miles
Length of shore line at elevation 1008,	50 miles
Area of swamp and overflowed land required,	8,943 acres
Area of dry and tillable land required,	8,485 acres
Number of houses submerged or affected,	53
Number of barns submerged or affected,	56
Improved and relocated highways,	11 miles
Track elevation, E. & P. Railroad,	1.70 miles
Total capacity of reservoir at 1008 flow line,	8,182,300,000 cu. ft., or 61,204,000,000 gal.
Maximum storage required to maintain 450 sec. ft. flow at Sharon,	5,060,000,000 cu. ft., or 37,848,800,000 gal.
Estimated cost per million cubic feet reservoir capacity,	$191 00
Estimated cost per million gallons reservoir capacity,	$25 60
Estimated cost per million cubic feet utilized storage,	$309 00
Estimated cost per million gallons utilized storage,	$41 40

FORCE EMPLOYED.

The Commission expresses appreciation of the industry and ability displayed by the force employed on this work. The organization by which the surveys, maps, plans and computations were made was as follows:

Engineer—Water Supply Commission,	Farley Gannett.
Field Engineer,	E. E. Haslam.
Assistant Engineer,	R. J. Ferris.
Instrumentman and Draftsman	B. A. Knight.
Office Engineer	R. C. Batley.
Recorder	J. P. Hannum.
Statistician	T. C. McCune.

RODMEN	D. R. Mackey, Byron Mackey, E. A. Hathaway, Ernest Thompson, R. McLinton, Frank Turner.
GAGE READERS	C. E. Jewell, S. A. Marvin. Gilbert Pollock,

EXPENDITURES.

An account of the expenditures made of the appropriation available by the Act of June, 14th, 1911, P. L. 288, under which this work was performed, is found below:

Amount appropriated,		$10,000 00
Salaries of Field Engineer and Assistants,	$7,593 71	
Travelling expenses, Water Supply Commission,	118 86	
Travelling expenses, Field Force,	1,507 43	
Rent of Field Office,	60 00	
Material and supplies,	168 61	
Postage,	7 44	
Express,	18 57	
Telegrams,	7 30	
Borings,	250 00	
Photographs,	86 30	
Blue prints,	11 31	
Total,		9,829 53
Balance from appropriation,		$170 47

Detailed information upon which the foregoing report is based is given in the pages following.

Respectfully submitted,

JOHN BIRKINBINE, Chairman,
FREDERIC W. FLEITZ,
THOMAS J. LYNCH,
SAMUEL G. DIXON, Commissioner of Health,
ROBERT S. CONKLIN, Commissioner of Forestry.
WATER SUPPLY COMMISSION OF PENNSYLVANIA.

Detailed Report

Data Collected, Engineering Studies and Results

⁂

DETAILED REPORT.

INTRODUCTORY.

In carrying out the provisions of the Act of the Legislature of 1911, the investigations, surveys, plans, maps, calculations, estimates, stream gagings and test borings were made, so far as time and funds permitted, with the same accuracy that would be required if construction on the project had been ordered. Such work is necessarily expensive, but without it the quantity of water available for regulation and the cost of the reservoir project, within reasonable limits, could not have been correctly estimated. The fundamental basis of the engineering research and determination of the feasibility of the project, summarized in the foregoing report, will be found in the following detailed description.

DESCRIPTION OF SHENANGO RIVER.

The reservoir project herein reported on would affect a considerable regulation in both the Shenango and Beaver rivers, and it is pertinent to describe the location and principal features of these two streams, their valleys and also the reservoir area.

The Shenango river, which flows into the Ohio river by way of the Beaver river, 25 miles below Pittsburgh, is one of the largest and most important streams of that part of the State, its lower valley being industrially active and supporting a dense population.

It rises in the southwestern part of Crawford County, thirty-five miles southeast of Erie, and about five miles southwest of Conneaut Lake, its ultimate source being the Phymatuning Swamp, which lies in the form of a crescent, about seventeen miles long, with a maximum width of about two miles, covering some sixteen square miles. The Shenango drains the western, and Crooked creek the eastern, section of the swamp, the two streams flowing southerly, to meet at Greenville, Mercer County, the latter stream having previously joined with the Little Shenango river.

In Crawford County the Shenango river flows through a fairly broad valley, after leaving the swamp, with well cultivated, rolling hills on either side; it is essentially an agricultural region, there being a few small industries in the two boroughs of Linesville and Hartstown, whose populations, in 1910, were 833 and 135, respectively. Entering Mercer County the river continues southerly, the character of the valley and surrounding territory remaining much as in Crawford County, until Greenville, population 5,909, is reached, where the first evidence of extensive industry, considerable population and water utilization appear.

At Greenville the stream is used by a grist mill for water power and, by manufacturing plants for industrial water supply, while the Little Shenango is employed for the domestic supply of the borough. Below and above Greenville the stream is followed by the Erie and Pennsylvania Railroads, but a short distance below Greenville the river enters the "Big Bend," where, in a swing to the east and then west, the river flows some seventeen miles to Sharpsville, the railroad cutting across the bend in 6.5 miles. In this section of broad and cultivated valley is probably the only undeveloped and practicable waterpower site of importance.

Sharpsville, population 3,634, is an active steel center, the plants including seven blast furnaces, and the temperature of the water, in low and medium stages, is appreciably raised by use for cooling and its appearance and quality show plainly the effect of increasing density of population and industry. At this point a large tributary, Pymatuning creek, enters from Ohio. From Sharpsville to Sharon, 4.5 miles the river has a narrow valley and steep banks, its southern course being continued and both banks being followed by railroads.

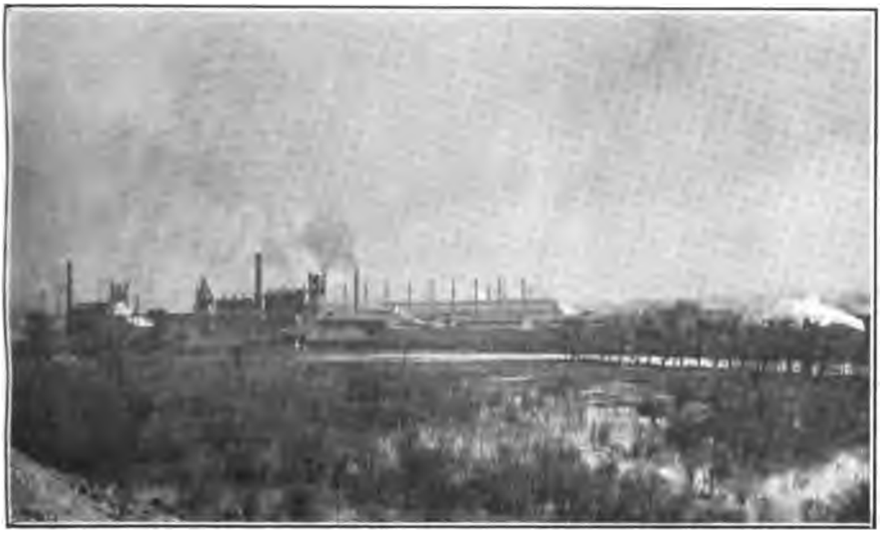
Sharon, population 15,270, and Farrell, formerly South Sharon, population 10,190, form a great industrial center of this valley, in which steel and iron works of various kinds line the banks for miles, withdrawing many million gallons of water from the river daily and discharging back the heated water and manufacturing wastes. The two boroughs obtain a water supply from the stream and their sewage, garbage and other city wastes are deposited therein. Much of the river, through these boroughs, is walled in on both sides, bridges cross the stream and bars and waste deposits obstruct the channel. At Farrell Big Yankee run, a large tributary, enters from Ohio and at this point the water of the stream, in summer, reaches a high temperature, owing to repeated use, and it is discolored by industrial and city wastes.

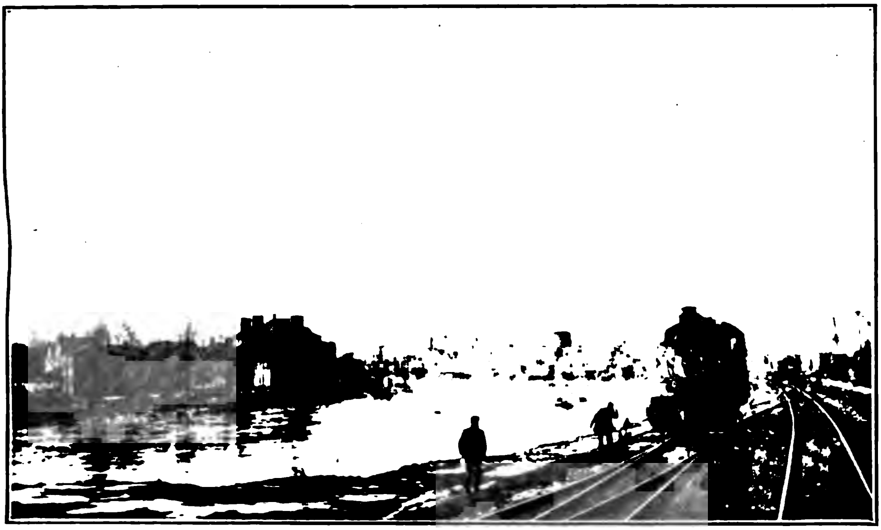
Continuing southward the stream is followed by railroads, close to its shores, through Wheatland and West Middlesex, population 955 and 1,157, respectively, where steel and iron works again use its waters. The banks are low and the valley wide, with much pasture and agricultural land, frequently inundated by floods, until New Castle, population 36,280, is reached, where the third great industrial center is located.

At New Castle the largest consumption of water occurs, and at low seasons the entire stream flow is re-used several times, with corresponding effect upon its temperature and quality. Here the stream is joined by its largest tributary, Neshannock creek, from the east. Four miles to the south of New Castle the Shenango joins the Mahoning river from Ohio, the shores to this point being largely occupied by railroads and industrial works. At Mahoningtown, just above the mouth of the Mahoning river, is a dam and water power development utilized by a grist and flour mill.

DESCRIPTION OF BEAVER RIVER.

The Shenango river, reinforced by the Mahoning river, just below New Castle, forms the Beaver river, the stream flowing southward and receiving one of its largest tributaries, Connoquenessing creek, from the east, to Beaver Falls, where, in the five and one-half miles to its confluence with the Ohio river, the stream bed drops fifty-five feet and has been utilized at three dams, for water power. Both sides of the Beaver river are thickly populated and the banks lined with varied industries in the boroughs of Beaver Falls, New Brighton, Fallston, Beaver, West Bridgewater, Rochester and others, whose combined population is 34,472.





Shenango River at Sharon.

Beaver River at Beaver Falls.

The total length of the Shenango and Beaver rivers, from the source of the former to the mouth of the latter, is approximately 110.5 miles.

The following table illustrates the relative size of the tributaries of the Beaver and Shenango rivers.

TABLE NO. 5.

Drainage Areas of Shenango and Beaver Rivers.

Stream.	Tributary to	Drainage Area at	Drainage aera in square miles.
Beaver river,	Ohio river,	Rochester,	3040
Mahoning river,	Beaver river,	Mahoningtown,	1070
Connoquenessing creek,	Beaver river,	Ellwood Junction,	826
Neshannock creek,	Shenango river,	New Castle,	243
Shenango river (exclusive of Neshannock creek.)	Beaver river,	New Castle,	804
Shenango river,	Beaver river,	Sharon,	605
Shenango river, (including Little Shenango).	Beaver river,	Greenville,	297
Little Shenango river,	Shenango river,	Greenville,	108
Shenango river,	Beaver river,	Proposed dam site,	150
Shenango river,	Beaver river,	Foot of Pymatuning Swamp,	110

The following table indicates the slope of the Shenango and Beaver rivers from source to mouth.

TABLE NO. 6.

Slope of Shenango and Beaver Rivers.

From	Elevation.	To	Elevation.	Miles.	Fall in feet.	Feet per mile.
Source,	1050	Edge Swamp,	1020	0.3	30.0	100.0
Edge Swamp,	1020	Blair Road,	1006	2.7	14.0	5.2
Blair road,	1006	P. R. R. Crossing in Swamp,	994.5	3.2	11.5	3.6
P. R. R. Crossing,	994.5	Manning Bridge,	985.5	5.5	9.0	1.6
Manning Bridge,	985.5	Westford Bridge, (End Swamp)	978.5	5.5	7.0	1.3
Westford Bridge,	978.5	Jamestown,	973	6.7	5.5	0.8
Jamestown,	973	Greenville, (Top Dam)	942	6.5	31.0	4.8
Greenville,	942	Sharpsville, (Canal lock)	866	24.8	76.0	3.1
Sharpsville,	866	Sharon, (Chestnut Street)	843	4.4	23.0	5.2
Sharon,	843	New Castle, (Washington street)	789	24.4	54.0	2.2
New Castle,	789	Mahoningtown, (Pool, Rainy dam)	773	2.6	16.0	6.2
Mahoningtown,	773	Beaver Falls, (Pool line, Hartman dam)	734	18.3	39.0	2.1
Ellwood Junction,	734	Ohio River,	668	5.6	66.0	11.8

DESCRIPTION OF PYMATUNING SWAMP.

Pymatuning Swamp is an extensive, preglacial lake, or river bed, filled to a great depth at some points with glacial drift, lying at the source of the Shenango river and Crooked creek, in the southwestern part of Crawford County. Previous to the glacial epoch, this valley probably drained northward into the Great Lakes, but the recession of the glacier left its northern outlet blocked and the drainage turned southward; the western and largest portion by way of the Shenango river and the eastern through Crooked creek.

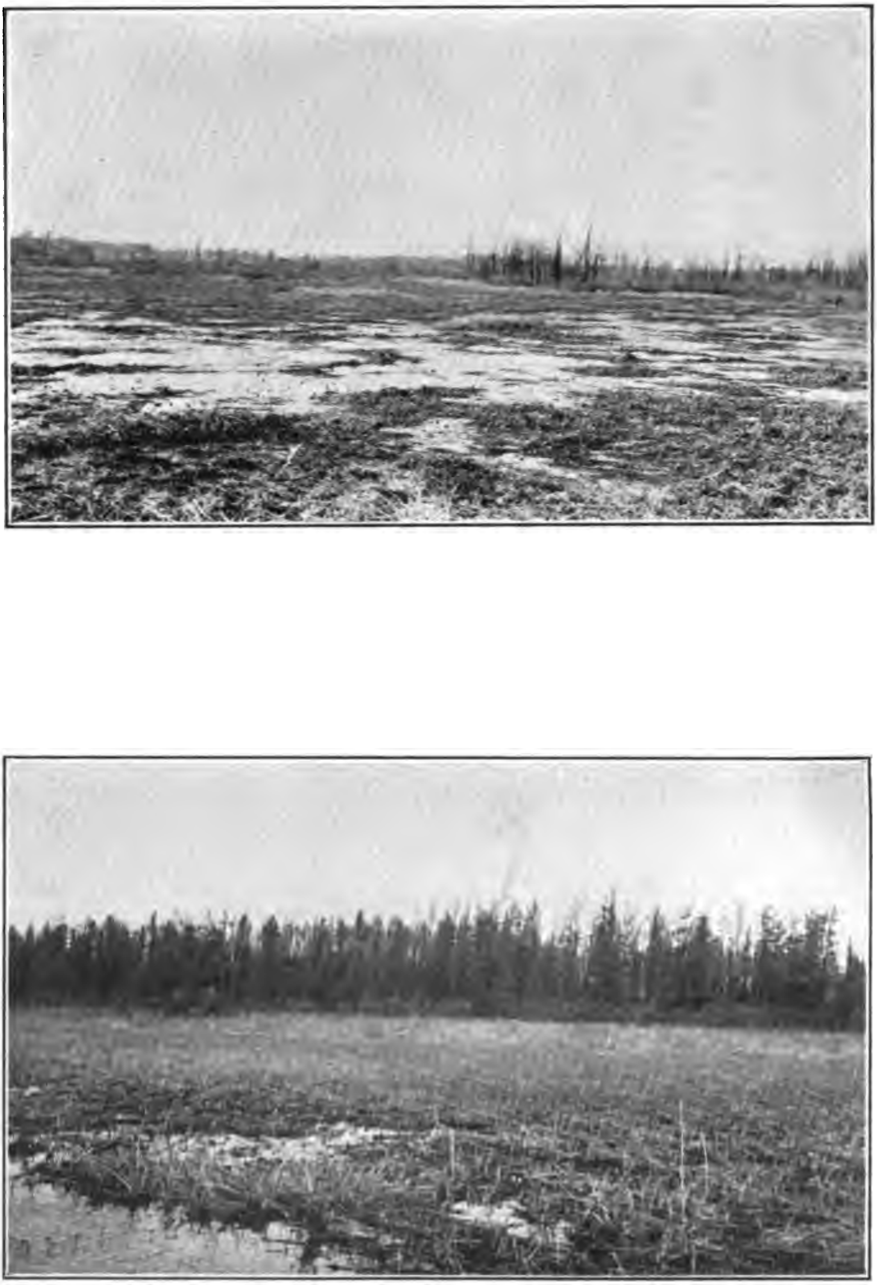
The area known as Pymatuning Swamp, comprising about 10,400 acres, consists of three distinct classes of land:

1. The morass, a sometimes inpenetrable, muck covered, thickly timbered swamp, in the central part of the district adjoining the river and its main tributaries;
2. Territory submerged during considerable portions of the year, and traversable at other times, but which is waste land, largely covered with brush and timber;
3. Land periodically flooded, and in some degree under cultivation, but generally devoted to pasturage or covered with timber.

Bordering these lands, which usually lie from 10 to 20 feet above the river level, are broad, sloping fields, suited to and largely under cultivation. In the vicinity of Linesville, on the north side of the swamp, 448 acres of morass have been reclaimed by drainage ditches, and the rich, black muck has been successfully devoted to onion culture.

The source of the river is at elevation 1,050 feet above sea level, the stream falling 30 feet in one-quarter of a mile to the swamp through which it winds westward in a narrow channel, impassible by boats owing to fallen timbers, brush, and shallow depth, through a tamarack and hardwood forest, for nine miles, being joined in this distance by Linesville creek, Bennett run and Paden creek. It thence swings southward, traversing the swamp for eight miles, emerging from the morass one-half mile below the Westford Bridge, at an elevation of 978 feet above the sea, and having an average slope throughout the swamp of 2.4 feet per mile. From the upper end of the swamp to the Pennsylvania Railroad crossing, the average slope is 4.3 feet per mile for 5.9 miles and from there to Manning Bridge 1.65 feet per mile. From this point to the dam site, 9.5 miles, the slope is 1.2 feet per mile. At Manning Bridge the total area draining into the swamp is 110 square miles, and the wide, flat valley continues southward about 4.2 miles, receiving additional tributary drainage, to the proposed dam site. The lower portion of the valley is a gravel and clay filled plain from one-half mile to 2 miles wide, the river winding from side to side, and skirted by

Swamp in Reservoir Site near Linesville.



Reclaimable Swamp Land at Upper End of Reservoir.

marshy, well timbered lands, subject to overflow. The morass, however, is not in evidence, as the creek has cut deeply into the soil. The western portion of the swamp extends into Ohio.

The surrounding highlands are gravel and clay hills, underlain with sandstone, the surface well cultivated, sparsely timbered, but not highly productive, classified as the Volusia soils, which cover in general the western part of the State. Several islands rise from the swamp, some being occupied and cultivated.

Linesville borough is on the northern border of the swamp on the sloping hillside, and Hartstown borough to the south is near the eastern end thereof. The small village of Espyville lies directly across the swamp and to the south of Linesville. About opposite the lower end of the swamp, and 2.5 miles west thereof, in Ohio, is the town of Andover, population 902.

Three railroad lines supported in fills, and several wagon roads cross the swamp, most of the latter being impassable for portions of each year, due to the rise of the water in the swamp, for few are elevated materially above its level.

POPULATION IN THE SHENANGO AND BEAVER RIVER VALLEYS.

The valleys of the Shenango and Beaver rivers, with the exception of the upper portion of the Shenango in Crawford County, in and surrounding the reservoir site, are among the most active industrially and consequently among the most densely populated of the State. To show the industrial activity of this region, and the consequent rapid increase in population therein, a comparison has been made of the increase in population in this section with that of the entire state, while to indicate the development of that portion of Crawford County surrounding the reservoir site, similar data is given.

The counties in Western Pennsylvania which will be influenced by the proposed reservoir, and regulated rivers, are Crawford, Mercer, Lawrence and Beaver, and the following statistics are submitted. During the decade from 1890 to 1900, the increase in population in the State of Pennsylvania was 19.9 per cent. and during the decade from 1900 to 1910 there was an increase of 21.6 per cent. By referring to Table No. 7 it will be noted that during the last decade, Crawford County decreased in total population 3.3 per cent., while its rural population decreased 9.7 per cent.; Mercer County increased 35.4 per cent., a gain over the average of the State of 13.8 per cent.; Lawrence County increased 22.8 per cent., a similar gain of 1.2 per cent., while Beaver County increased 38.8 per cent., or 17.2 per cent., above the mean increase in the State.

There has been a decline in the rural population of Crawford County for the past 20 years, a slight loss in Mercer County during the past ten years, an increase of about 10 per cent. in Lawrence County, while the rural population in Beaver county has remained about constant.

The urban population in Mercer, Lawrence and Beaver counties has increased rapidly due to the development of the Shenango and Beaver valleys, principally through its iron and steel industries. The most notable growths are in New Castle, which increased from a total population of 11,600, in 1890, to 36,280, in 1910; Sharon, from 7,459 to 15,270 in the same period, and South Sharon, which was incorporated in 1901, and is now known as Farrell, with a population of about 5,000 had increased to 10,190 in the year 1910. The total population in the Shenango and Beaver valleys, in the townships, boroughs and cities bordering on the Shenango and Beaver rivers, with the exception of the townships in Ohio, as shown by the United States Census of 1910, was 154,775, of which 150,124 were located in Mercer, Lawrence and Beaver counties. The urban population in this district, 110,436, increased about 37 per cent. in the last decade; while that of the rural district, 39,688, increased 2.6 per cent. The increase in combined urban and rural population from the Crawford-Mercer county line to the Ohio river has been 25.8 per cent.

In Crawford County, in the townships adjacent to the proposed reservoir, there were 4.651 people in 1910, of which 968 lived in the boroughs of Hartstown and Linesville and the remaining 3,683 scattered throughout the country districts. During the past decade Hartstown decreased 27.4 per cent. and Linesville increased 26.0 per cent.; while the rural population declined 16.2 per cent., resulting in a reduced population of about 11.3 per cent. for the combined townships and boroughs.

The information from which this summary is made is given in detail in the following tables, taken from the United States Census for 1890, 1900 and 1910.

TABLE NO. 7.

Population of Counties Along Shenango and Beaver Rivers.

County.	Area in square miles.	Population per sq. mile in 1910.	Rural population per sq. mile in 1910.	Total population 1910.	Total population 1900.	Total population 1890.	Increase (+) or decrease (—) 1900 to 1910.	Increase (+) or decrease (—) 1890 to 1900.
Crawford,	1038	59.3	38.8	61,565	63,643	65,324	—3.3*	—2.6
Mercer,	700	111.0	55.7	77,699	57,387	55,744	+35.4	+2.9
Lawrence,	360	194.5	82.9	70,032	57,042	37,517	+22.8	+52.0
Beaver,	429	182.6	85.9	78,353	56,432	50,077	+38.8	+12.7

Increase population in State of Pennsylvania 1890 to 1900 = +19.9%.
Increase population in State of Pennsylvania 1900 to 1910 = +21.6%.
*Rural population in Crawford county decreased 9.7 per cent 1900 to 1910.

TABLE NO. 8.

Summary of Population of Minor Civil Divisions in Shenango and Beaver River Valleys.

Counties.	Population of Cities, Towns, Borough and Townships bordering on the Shenango and Beaver rivers.				Percentage. — = Decrease. + = Increase.	
	Population.					
	Distribution.	1910	1900.	1890.	1900 to 1910.	1890 to 1900.
Crawford, ...	Boroughs and towns, ...	968	847	712	+14.3	+ 19.0
-	Townships, ...	3,683	4,394	4,796	—16.2	— 8.4
	Total, ...	4,651	5,241	5,508	—11.3	— 4.8
Mercer, Lawrence and Beaver, ...	Cities and boroughs, ...	110,436	80,718	50,462	+36.8	+ 60.0
	Townships, ...	39,686	38,665	34,543	+ 2.6	+ 12.0
	Total, ...	150,124	119,383	85,006	+25.8	+ 40.5
Mercer, ...	Cities and boroughs, ...	38,153	24,339	15,826	+59.0	+ 53.6
	Townships, ...	13,101	13,479	12,797	— 2.8	+ 5.3
	Total, ...	51,254	37,818	28,623	+35.5	+ 32.1
Lawrence, ...	Cities and boroughs, ...	37,811	29,155	12,366	+29.7	+135.8
	Townships, ...	18,911	17,577	15,101	+ 7.6	+ 16.4
	Total, ...	56,722	46,732	27,467	+21.4	+ 70.1
Beaver, ...	Cities and boroughs, ...	34,472	27,224	22,270	+26.6	+ 22.2
	Townships, ...	7,676	7,609	6,645	+ 0.9	+ 14.5
	Total, ...	42,148	34,833	28,915	+21.0	+ 20.4

TABLE NO. 9.

Population of Boroughs and Cities Bordering on the Shenango and Beaver Rivers.

Counties.	Population.				Percentage. — = Decrease. + = Increase.	
	City or Borough.	1910.	1900.	1890.	1900 to 1910.	1890 to 1900.
Crawford, ...	Hartstown, ...	185	186	160	— 27.4	+ 16.2
	Linesville, ...	833	661	552	+ 26.0	+ 19.8
	Total, ...	968	847	712	+ 14.3	+ 19.0
Mercer, ...	Jamestown, ...	822	834	822	— 1.4	+ 1.4
	Greenville, ...	5,909	4,814	3,674	+ 22.8	+ 31.0
	Clarksville, ...	216	220	....	— 1.8	....
	Sharpsville, ...	3,634	2,970	2,330	+ 22.4	+ 27.4
	Sharon, ...	15,270	8,916	7,459	+ 71.3	+ 19.5
	Farrell, ...	10,190	*5,000	....	+103.7	....
	Wheatland, ...	955	655	575	+ 45.9	+ 14.0
	West Middlesex, ...	1,157	930	966	+ 24.4	— 3.7
	Total, ...	38,153	24,339	15,826	+ 59.0	+ 53.6
Lawrence, ...	New Castle, ...	36,280	28,339	11,600	+ 28.0	+144.3
	So. New Castle, ...	551	....	....	....	....
	Wampum, ...	980	816	766	+ 20.1	+ 6.5
	Total, ...	37,811	29,155	12,366	+ 29.7	+135.8
Beaver, ...	Eastville, ...	322	256	....	+ 25.8	....
	College Hill, ...	1,787	890	....	+100.7	....
	Beaver Falls, ...	12,191	10,054	9,735	+ 21.2	+ 3.2
	Patterson Heights, ...	367	272	....	+ 34.9	....
	New Brighton, ...	8,329	6,820	5,616	+ 22.2	+ 21.4
	Fallston, ...	555	549	541	+ 1.1	+ 1.4
	Bridgewater, ...	1,562	1,347	1,177	+ 16.0	+ 14.4
	Rochester, ...	5,903	4,688	3,649	+ 25.9	+ 28.4
	Beaver, ...	3,456	2,348	1,552	+ 47.1	+ 51.2
	Total, ...	34,472	27,224	22,270	+ 26.6	+ 22.2

*Estimated.

TABLE NO. 10.

Population of Townships Bordering on the Shenango and Beaver Rivers.

Counties.	Population.				Percentage. — = Decrease. + = Increase.	
	Township.	1910.	1900.	1890.	1900 to 1910.	1890 to 1900.
Crawford, ...	Sadsbury, ...	380	758	845	....	....
	N. Shenango, ...	687	711	804	....	....
	Pine, ...	339	336	351	....	....
	Conneaut, ...	1,230	1,477	1,559	....	....
	So. Shenango, ...	820	835	909	....	....
	West Shenango, ...	227	277	328	....	....
	Total, ...	3,683	4,394	4,796	— 16.2	— 8.4
Mercer, ...	Greene, ...	519	689	762	....	....
	Hempfield, ...	1,083	858	951	....	....
	West Salem, ...	1,996	1,838	2,043	....	....
	Pymatuning, ...	1 846	1,828	*1,800	....	....
	Delaware, ...	195	1,323	1,480	....	....
	Jefferson, ...	819	923	982	....	....
	Hickory, ...	4,553	4,865	3,639	....	....
	Shenango, ...	1,090	1,155	1,140	....	....
	Total, ...	13,101	13,479	12,797	— 2.8	+ 5.3
Lawrence, ...	Pulaski, ...	1,606	1,607	1,609	....	....
	Mahoning, ...	3,239	2,617	2,079	....	....
	Neshannock, ...	1,213	1,080	1,171	....	....
	Union, ...	2,626	2,065	1,445	....	....
	Taylor, ...	1,228	571	1,374	....	....
	Shenango, ...	2,425	2,806	2,004	....	....
	North Beaver, ...	2,377	2,245	2,085	....	....
	Big Beaver, ...	1,287	1,488	1,647	....	....
	Wayne, ...	2,910	3,108	1,787	....	....
	Total, ...	18,911	17,577	15,101	+ 7.6	+ 16.4
Beaver, ...	Big Beaver, ...	1,442	1,380	1,497	....	....
	North Sewickley, ...	1,820	1,660	1,154	....	....
	Chippewa, ...	494	527	571	....	....
	Patterson, ...	434	433	529	....	....
	Daugherty, ...	699	533	....	....	....
	Pulaski, ...	805	728	1,196	....	....
	Brighton, ...	755	687	773	....	....
	Rochester, ...	1,227	1,661	925	....	....
	Total, ...	7,676	7,609	6,645	+ 0.9	+ 14.5

*Estimated.

ASSESSED PROPERTY VALUATION.

In reasonably inexpensive and efficient water storage projects it will be found that the reservoir is usually located in a section of low land values, sparse population and few industries, while the district receiving the most benefit through the regulation effected is of an opposite character. Thus the smaller the population and the lower the value of land in and about the reservoir site, the less the project costs per unit of volume; and the more dense the population and higher the value of land and industries along the regulated stream below the reservoir, the greater the resulting benefit.

The Pymatuning project exhibits these factors in a striking degree, as shown by the following tables, which give the assessed valuation of the townships in and surrounding the swamp, and the boroughs adjacent thereto, together with the assessed valuation of townships, boroughs and cities along the Shenango and Beaver rivers below the dam site.

The total assessed value of the boroughs and townships in the reservoir district is $4,071,841, while that of those below in the district to be benefitted as $68,007,527, or over 16 times as great. The value of incorporated places adjacent to the swamp is $194,740, and that of the boroughs and cities on the Shenango and Beaver rivers is $50,503,334, or over 250 times as much.

TABLE 11.

Assessed Valuation of Cities, Boroughs and Townships Bordering the Shenango and Beaver Rivers in Ohio and Pennsylvania.

RESERVOIR DISTRICT.

State.	County.	Name of City, Borough or Township.	Valuation of city or borough.	Valuation of township.	Total.
Ohio,	Ashtabula,	Richmond,	....	$514,308	....
Ohio,	Ashtabula,	Andover,	....	623,438	....
Ohio,	Ashtabula,	Williamsfield,	....	840,475	....
Total,	....	....	....	$1,978,221	$1,978,221
Pennsylvania,	Crawford,	Pine,	....	109,780	....
Pennsylvania,	Crawford,	Linesville,	$194,740	....	....
Pennsylvania,	Crawford,	Conneaut,	....	559,885	....
Pennsylvania,	Crawford,	N. Shenango,	....	331,305	....
Pennsylvania,	Crawford,	S. Shenango,	....	370,560	....
Pennsylvania,	Crawford,	W. Shenango,	....	118,880	....
Pennsylvania,	Crawford,	Sadsbury,	....	408,470	....
Total,	....	....	$194,740	$1,898,880	$2,093,620
Grand total,	....	....	$194,740	$3,877,101	$4,071,841

Shenango and Beaver River District.

State.	County.	Name of City, Borough or Township.	Valuation of city or borough.	Valuation of township.	Total.
Pennsylvania,	Mercer,	Green,	....	$381,451	....
Pennsylvania,	Mercer,	Jamestown,	$228,900	....	....
Pennsylvania,	Mercer,	Hempfield,	....	501,436	....
Pennsylvania,	Mercer,	Greenville,	2,278,450	....	....
Pennsylvania,	Mercer,	West Salem,	....	833,777	....
Pennsylvania,	Mercer,	Pymatuning,	....	994,894	....
Pennsylvania,	Mercer,	Clarksville,	38,451	....	....
Pennsylvania,	Mercer,	Delaware,	....	688,889	....
Pennsylvania,	Mercer,	Jefferson,	....	479,977	....
Pennsylvania,	Mercer,	Hickory,	....	1,596,461	....
Pennsylvania,	Mercer,	Sharpsville,	1,742,415	....	....
Pennsylvania,	Mercer,	Sharon,	6,682,929	....	....
Pennsylvania,	Mercer,	Farrell,	5,939,496	....	....
Pennsylvania,	Mercer,	Wheatland,	....	405,896	....
Pennsylvania,	Mercer,	Shenango,	....	664,408	....
Pennsylvania,	Mercer,	West Middlesex,	562,450	....	....
Total,	....	....	$17,473,090	$6,547,183	$24,020,273

State.	County.	Name of City, Borough or Township.	Valuation of city or borough.	Valuation of township.	Total.
Pennsylvania,	Lawrence,	Pulaski,	....	$790,082	....
Pennsylvania,	Lawrence,	Mahoning,	....	902,696	....
Pennsylvania,	Lawrence,	Neshannock,	....	544,190	....
Pennsylvania,	Lawrence,	New Castle,	$16,872,858	....	....
Pennsylvania,	Lawrence,	Union,	....	638,459	....
Pennsylvania,	Lawrence,	Taylor,	....	438,241	....
Pennsylvania,	Lawrence,	Mahoningtown,	902,696	....	....
Pennsylvania,	Lawrence,	Shenango,	....	684,689	....
Pennsylvania,	Lawrence,	N. Beaver,	....	1,406,889	....
Pennsylvania,	Lawrence,	West Pittsburg,	....	....	....
Pennsylvania,	Lawrence,	Moravia,	....	....	....
Pennsylvania,	Lawrence,	East Moravia,	....	....	....
Pennsylvania,	Lawrence,	Big Beaver,	....	530,671	....
Pennsylvania,	Lawrence,	Wayne,	....	561,050	....
Total,	....	....	$17,775,554	$6,496,917	$24,272,471

Shenango and Beaver River District—Continued.

State.	County.	Name of City, Borough or Township.	Valuation of city or borough.	Valuation of township.	Total.
Pennsylvania, .	Beaver, ...	Big Beaver, ...	....	$579,634	....
Pennsylvania, .	Beaver, ...	N. Sewickley, ...	....	537,744	....
Pennsylvania, .	Beaver, ...	Chippewa, ...	....	330,140	....
Pennsylvania, .	Beaver, ...	Patterson, ...	....	201,265	....
Pennsylvania, .	Beaver, ...	Patterson Heights, ...	$218,308	....	....
Pennsylvania, .	Beaver, ...	Daugherty, ...	....	389,019	....
Pennsylvania, .	Beaver, ...	Pulaski, ...	....	229,669	....
Pennsylvania, .	Beaver, ...	Brighton, ...	....	604,133	....
Pennsylvania, .	Beaver, ...	Rochester, ...	....	588,489	....
Pennsylvania, .	Beaver, ...	Beaver Falls, ...	4,983,670	....	....
Pennsylvania, .	Beaver, ...	New Brighton, ...	3,535,060	....	....
Pennsylvania, .	Beaver, ...	Fallston, ...	343,707	....	....
Pennsylvania, .	Beaver, ...	West Bridgewater, ...	440,005	....	....
Pennsylvania, .	Beaver, ...	Rochester, ...	2,909,780	....	....
Pennsylvania, .	Beaver, ...	Beaver, ...	2,814,165	....	....
Total, ...	....	....	$15,254,690	$3,460,093	$18,714,783
Grand total of Mercer, Lawrence and Beaver counties, ...			$50,503,334	$17,514,193	$68,007,527

CONSUMPTION OF WATER FROM SHENANGO RIVER.

A census of the domestic and industrial use of water from the Shenango river, from Greenville to its junction with the Mahoning and of the Beaver river, taken for this report, in the fall of 1912, indicated a draft upon this stream of extraordinary proportions, due to activity along industrial lines. It was found that the total volume of water drawn from this river, from its source to the mouth, is 230,000,000 gallons per day, or at the rate of 2,090 gallons per capita daily for the population of the boroughs and cities bordering the stream, equivalent to two-thirds of the quantity of water claimed to be used by the City of Philadelphia, which has a population of one million and one-half, and approximately three times the present consumption of the Greater Pittsburgh municipal works. The total consumption is at the rate of three hundred and fifty-six cubic feet per second, or eighteen times the minimum stream flow recorded at Sharon and about thirteen times the minimum flow recorded at New Castle. The greater portion of this water, after being used, is returned to the stream to be repeatedly pumped therefrom, used, and returned. During the low water periods of 1908-9 and 10 the large industries were running below their full capacities, requiring only a fraction of their full demands, but under these conditions the flow proved entirely insufficient and shut-downs of greater or less duration were necessary. At the time the above mentioned census was taken, the plants were generally running to their full capacities and the figures represent probably the present full demand.

Table No. 12 shows the use of water from the Shenango by municipal water supply companies.

TABLE 12.

Domestic Use of Water From the Shenango River.

Place.	Gallons per 24 hours.
Sharpsville,	300,000
Sharon,	1,700,000
New Castle,	3,600,000
Total,	5,600,000

Greenville, which lies at the mouth of the Little Shenango, obtains its supply from that stream.

The present daily consumption of water for domestic use in Sharpsville, Sharon, Farrell and New Castle, based on the data shown in the above Table 12, is about eighty-five gallons per capita and if the entire urban population from Jamestown to New Castle in 1910 had secured its domestic supply from the Shenango river, the consumption for that purpose, on the basis of eighty-five gallons per capita, would have been approximately 6,500,000 gallons daily. The probable consumption in the year 1920, assuming the same rate of increase in population as occurred between 1900 and 1910, would be 8,200,000 gallons daily for a probable population of about 96,000. The water companies which supply these towns furnish a considerable volume, in addition to that required for domestic use, to the smaller industries, thus, at Sharon and Farrell 140,000 gallons, and at New Castle 671,000 gallons per day are supplied for industrial purposes.

The domestic supply of water reaches insignificance when compared with that pumped directly from the river for industrial use, by the manufacturing companies themselves, as appears by the following table:

TABLE 13.

Industrial Use of Water From the Shenango River.

Place.	Gallons per 24 hours.
Linesville to Greenville, inclusive,	3,250,000
Sharpsville,	16,251,000
Sharon,	27,390,000
Farrell,	75,345,000
Wheatland to Middlesex,	4,000,000
New Castle, West Pittsburg and Crescentdale,	90,582,000
Total,	217,868,000

In addition to the above, record has been obtained of a consumption of 1,150,000 gallons for industrial use, pumped from drilled wells and a small portion of the industrial consumption is obtained from dug wells, adjacent to the stream. Some of the industries at New Castle obtain their water from Neshannock creek in addition to that above noted. The probable demand for water from the Shenango river for industrial use, in the year 1920 is estimated to be approximately 280,000,000 gallons, or about 435 cubic feet per second. It is, therefore, reasonable to expect that there will be required for industrial and domestic use, along the Shenango river, ten years hence, a daily demand of about 290,000,000 gallons, or about 450 cubic feet per second.

With the minimum flow in the Shenango river at Sharon so regulated that at no time would it decrease below 450 cubic feet per second, the consumption from this stream would be amply provided for. Under present conditions the industries at Sharpsville, Sharon, Farrell and New Castle withdraw practically the entire flow of the stream for considerable periods, each summer, and turn it back high in the temperature and manufacturing wastes, for the use of the next consumer. With the larger flow available, and only a fraction of it abstracted at any one point, the temperature of the water will remain lower and the quality higher than under present conditions, and its efficiency and usefulness for industrial purposes, and its purity and facility of filtration for domestic use will be increased.

CONSUMPTION OF WATER FROM BEAVER RIVER.

The minimum flow of the Beaver river is approximately 200 cubic feet per second, and, owing to the absence of large industrial consumers, the demand on the stream is smaller than that in the Shenango valley. Hydraulic power is used when available for pumping purposes by water companies, hence the power feature is an important one in the water supply problem. The total consumption for industrial and domestic purposes, in the Beaver Falls district, is approximately 6,000,000 gallons per day, of which approximately 4,000,000 gallons is pumped from the stream by the water companies. In this district about 200,000 gallons of water is pumped daily by industrial plants from drilled wells, and 375,000 gallons per day is purchased by industrial plants from the water companies.

FLOOD CONDITIONS.

The greatest benefit to be derived by the State and by the Shenango and Beaver valleys, from the construction of this reservoir, will be in the increased domestic and industrial supply, rather than through flood control, for the two purposes require different application of the impounded water. A full reservoir is best for domestic supply; an empty reservoir may be required to hold back a flood, but the purposes may be combined so that the supply for domestic and industrial use may be secured and at the same time the floods materially reduced. A reservoir for increasing the low flow may require a greater holding capacity than one, on the same stream, designed for flood prevention.

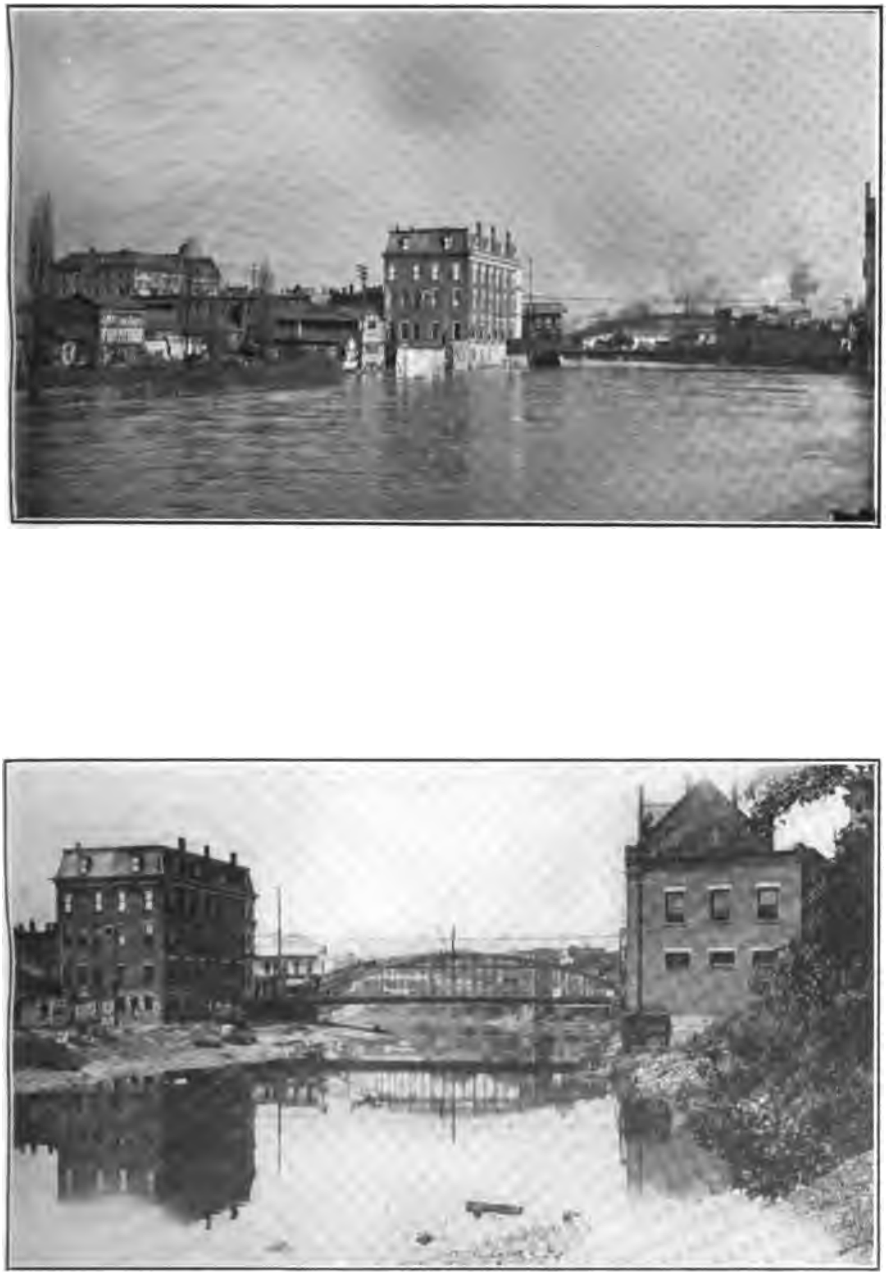
A study of the influence of the proposed reservoir upon flood conditions in the Shenango river at and below Sharon, made from stream measurements collected during the year 1912, demonstrated that the reservoir would reduce a flood of 10,000 cu. ft. per second at Sharon, corresponding to an eleven foot gage height, in an amount varying from .8 foot to 1.3 feet, depending on the condition of the ground water in Pymatuning Swamp and the contributary area. A thirteen foot gage height at Sharon, which represents a flood of 14,000 cu. ft. per second, would be reduced from 1.07 feet to 1.72 feet, and the maximum flood which occurred at Sharon on May 18, 1893, discharging 18,100 cubic feet per second would have been reduced about 2 feet.

The flood of 1893 was nearly equaled in 1910 and greater freshets may be expected. These reductions in flood heights would reduce the damage in the cities, and to the railroads, industries, farm lands, bridges and roads in the Shenango Valley.

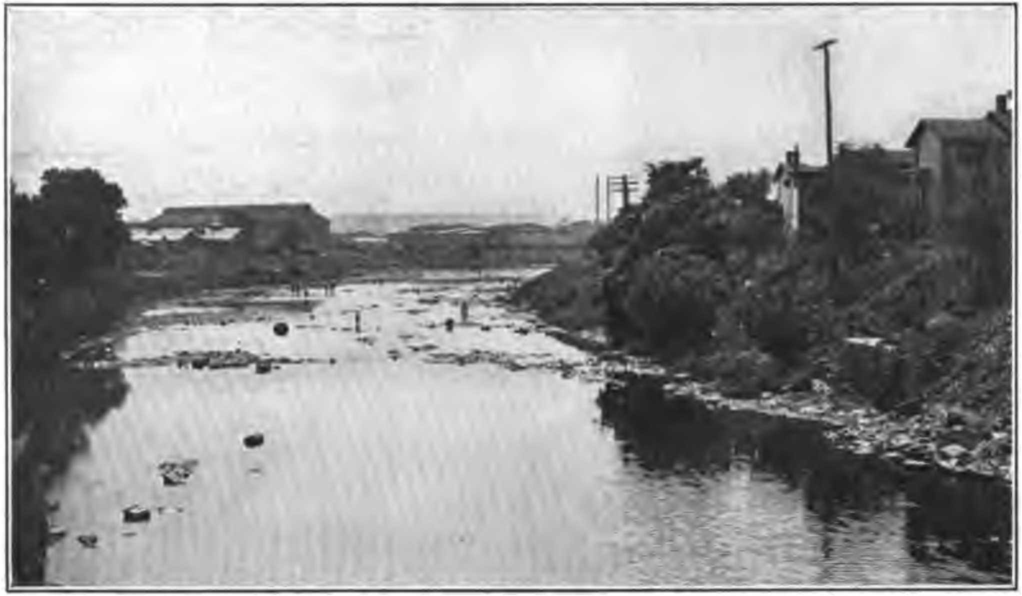
SANITARY CONDITIONS.

Where the Shenango and Beaver rivers pass through the larger centers of population they receive the unpurified sewage and trades waste thereof, the direct discharge from scores of private sewers, garbage, offall of various kinds, and city wastes, so that when the stream flow decreases, the dilution of this debris becomes less until a condition of gross pollution is often reached. This condition becomes so aggravated in seasons of drought at Sharon and New Castle having a large foreign population who have not yet entirely accustomed themselves to American standards of sanitation, as to become offensive. In the pools above dams and in other slack portions of the stream these conditions are particularly noticeable. During dry periods considerable portions of the exposed river bottom become littered with decomposing animal and vegetable matter, either left by the receding water or thrown in from the shores.

At Greenville, in summer and early fall, little or no water is passing over the dam, all of it either leaking through or passing into the stream by way of the mill and tailrace, exposing the stream bed below the dam for a considerable distance. Analyses of the river



Flood and Drought Conditions, Shenango River at Sharon.



Low Water, Shenango River at Greenville.

water at Sharon, West Pittsburgh, New Castle, Eastvale and New Brighton, invariably indicate Bacilli Coli usually in large numbers, showing gross pollution.

With the proposed reservoir in operation this would be changed; the normal channel would be filled at all seasons, sewage would be better diluted, the current reasonably rapid and debris and wastes dumped or thrown in the stream bed would be quickly carried away. At Sharon, the low water level would be increased 1.9 feet, and at other points a corresponding improvement would be effected.

Sanitarians estimate that six cubic feet per second will dilute the unpurified sewage of 1,000 inhabitants to such an extent as to prevent nuisance. With 25,000 people at Sharon and Farrell, if all were connected with the sewers, there would have to be at least 150 cubic feet per second flowing to properly dilute the sewage, whereas the minimum flow falls to 20 second feet, continuing below 100 second feet for weeks at a time and with the regulated minimum of 450 second feet the discharge of the sewage from three times the present population would be well diluted. Similar improvement would result at New Castle, and along the lower Beaver river where the flow is now insufficient for proper dilution.

Most of the large boroughs and cities along this stream have been ordered by the State Health Department to prepare plans for sewage purification plants, and it is not considered that this reservoir would relieve them of this necessity. Sharon, Sharpsville, New Castle and the towns along the lower Beaver River all use the river for their water supply. The companies supplying these towns filter the water and on account of its condition the operation of their plants is expensive. With the increased flow due to reservoir regulation, the concentration of impurities and germs in the water would be less, the operations of filtration plants would be reduced in cost and their efficiency increased.

WATER POWER.

The increase in the dry weather flow of the Shenango and Beaver rivers, would benefit the existing water powers thereon.

The populous and flourishing communities in the Shenango and Beaver Valleys below Greenville offer an attractive market for nearby power which might be obtained from these two streams, but the natural dry weather flow is so small and continues over such extended periods that little power has been developed. Dense population, numerous railroads and many industries which line the banks, preclude extensive development of this stream, which might be warranted if its flow was regulated by artificial means, but the present water power installations can be increased and some new power created if regulation is effected.

DEVELOPED WATER POWERS OF SHENANGO RIVER.

At Jamestown, Mercer County, three miles below the proposed dam site, a small grist mill develops water power under a head of 5.5 feet, for grinding flour and grain, the dam being 5.0 feet high.

At Greenville, a flour and feed mill is operated by water power from the Shenango river and Little Shenango combined, the dam being 9.5 feet high, and the total head 10½ feet. Two turbines are installed having a total capacity of 145 horsepower, under full load, and a gasoline auxiliary is in use much of the time during the summer months.

At New Hamburg, about 10 miles below Greenville, and *above* what is known as the "Big Bend of the Shenango," there is a flour and feed mill, which was rebuilt in 1911, and obtains water from a dam 2.5 feet high to drive a turbine, operating under a head of 6.0 feet, and developing 50 horsepower. This mill has no auxiliary plant and is subject to a reduction in output during dry weather and from backwater caused by floods.

At Clarksville, 10 miles above Sharon is a flour and feed mill operating under 3½ feet head, with a dam 4 feet high and having a rated installed capacity of 26 horsepower, obtained from 2 turbines. The mill is subject to backwater from the heavy discharge of Pymatuning creek, and during extreme floods the water has been about 2 feet above the mill flour.

At Pulaski, about 12 miles below Sharon, in Lawrence County, there is a flouring mill operating under 6.5 feet head and equipped with 5 turbines of a total rated capacity of 100 horsepower. This plant operates without reinforcement, but during extended dry periods has a reduced output, and during the recent floods was damaged.

At Mahoningtown immediately above the junction of the Shenango and Mahoning rivers, and four miles south of New Castle, a curved dam 420 feet long and 4 feet high formerly furnished power for a flour mill, equipped with four turbines of total rated capacity of 160 horsepower, under about 5 feet head.

The above includes all the present developments operated on the Shenango below the proposed reservoir, and indicates that of a total fall in the stream from Jamestown to the Mahoning river, of 105 feet, only 37.0 feet or 35% is developed for water power purposes. The aggregate installed capacity of these plants is 500 horsepower, and their combined minimum output does not exceed 75 twenty-four hour power. All of these mills are used for grinding grain, or other produce of the farm, and none of them take advantage of the adjacent market for electrical power and light.

UNDEVELOPED WATER POWER OF THE SHENANGO RIVER.

The wide meadow and swamp lands bordering the Shenango river flanked by comparatively high bluffs, would have offered before industry and population rendered it impracticable, opportunities for a fairly full utilization of the water power of this stream. One stretch of the Shenango river offers opportunity for the development of new power, i. e., from Kidd's Mill, below Greenville, to Sidel's dam, nine miles downstream. Along this stretch the stream sweeps in a curve to the east and thence back to the west, bordered by bluffs on one side and wide lowlands on the other. There are no towns or villages of importance and the railroads instead of following the long course of the river, leave the stream and take a shorter route between Greenville and Sharpsville. The head available is approximately 32 feet, and the pondage created by a dam would increase the low water output. The market would be Greenville, Sharpsville, and if necessary Sharon, utilizing the total head and with the flow regulated at 450 second feet, as proposed by the Pymatuning reservoir 1,300 primary, 24 hour power could be developed.

At the proposed Turnerville dam there is a possibility for operating an intermittent water power under a head varying from 23 to 31 feet. This power would necessarily be a variable one, its output depending upon the quantity of water needed to maintain the regulated minimum flow at Sharon. Its maximum output would occur at the time of the minimum in the stream farther down and might be used as an auxiliary operated with developments on the Shenango below.

Most of the grist mills on the stream could be improved by raising the dams to obtain more pondage and higher head, while in several cases head and tail races could be improved. By the construction of the Pymatuning reservoir, the available powers during low seasons would be increased and several of these mills might profitably be converted into, or combined with installations for the development of electricity. As shown by the following table, the mills which utilize the greatest head would be most benefitted.

TABLE 14.

Power Equivalent of Regulated Minimum Flow.

Head.	Minimum Discharge.	Horsepower.
2 feet,	450 cubic feet per second,	75
4 feet,	450 cubic feet per second,	150
6 feet,	450 cubic feet per second,	225
8 feet,	450 cubic feet per second,	300
10 feet,	450 cubic feet per second,	375
12 feet,	450 cubic feet per second,	450

Estimating the annual benefit to the owner of a water power by reason of the regulation of the stream flow, as approximately $10.00 for each added primary horsepower and assuming a benefit in trans-forming intermittent to primary power of $5.00 per horsepower, there would result an annual benefit to these properties with their existing installations amounting to $2,000. If their turbine installations were increased to utilize the entire regulated flow there would be a further annual benefit of approximately $8,900. Additional increase in value would accrue to these water powers from secondary power if still further increase in installations were made.

WATER POWER OF THE BEAVER RIVER.

In the 5½ miles above its mouth, the natural bed of the Beaver river falls approximately 55 feet, and this stretch was, many years ago, recognized as a source of power; dams were built, water wheels installed and an active industrial center established. Approximately 50 feet has been utilized by the construction of three dams at which wheels to the total capacity of 2,800 horsepower have been installed. Power is used for pumping water to supply the towns and villages on both sides of the stream, for generating electricity for lighting these towns and for various manufacturing purposes, such as flouring mills, planing mills, pottery, white lead, nail and wire works. In recent years, with the decreasing volume of dry weather flow these powers have become of less importance so that the industries dependent upon them have installed steam reinforcement plants. One of these dams has been partially destroyed by recent floods, so that much of the power is now lost. A fourth dam, at which there is no power developed, and is located just above the mouth and is flooded by backwater from the Ohio river.

The dam at New Brighton, three miles above the mouth is 15.5 feet high, 500 feet long, constructed as is the lower dam, of timber cribbing. From this dam there are two headraces, one on each bank of the stream, controlled by separate companies. Various manufacturing companies are utilizing the fall from the race to the river, the head varying from 15 feet to 20 feet. At times of excessive floods in the Ohio river, water backs up on this structure.

The Beaver Falls dam one mile above the New Brighton dam is 15 feet high, and of similar construction to the two below. There is but one race, and the power is divided into 200 shares, each said to be equal to about 12 horsepower. This dam has been recently partially destroyed and little or no power is being used from it at present.

At Eastvale, 5½ miles above the mouth and at the head of the rapid section of the river, is a dam of more recent construction, 14 feet high, 640 feet long, at which a total of 600 horsepower can be developed from the turbines installed, when sufficient water is available. The power is devoted entirely to pumping water for domestic and industrial supply.

The maintenance of a flow of 450 second feet at Sharon would insure a minimum flow available for power purposes along this stretch of the Beaver river of approximately 650 cubic feet per second. Of the 65 feet available fall, these dams and their races have developed approximately 50 feet and the records indicate that a total installation of 2,800 horsepower was in partial use previous to the injury to the second dam. The minimum flow used at a head of 50 feet would furnish 2,730 continuous horsepower as against the present minimum output of about 840 horsepower. On the same basis as that used above in connection with the improvement of the Shenango river powers, the improvement of the minimum flow would benefit these powers $9,500 per year. The proposed regulation would transform these powers from a present small value, except that at the upper dam, into a valuable primary power, augmented by a secondary power good for six months in the year of approximately 12,000 horsepower of such evident value that it would be developed and would be an asset to that community.

TEMPERATURE OF RIVER WATER.

The extensive and repeated use of the water of the Shenango river for cooling purposes, by the various steel mills along its course, results in raising its mean annual temperature above that of the air, and during the season of low flow a diminution in the supply available for domestic and other uses results from the abnormal evaporation which takes place at such times. Experiments on evaporation carried on in Pymatuning Swamp showed that the water, during June, July and August, 1912, averaged two degrees cooler than the air and that, under these conditions, the annual evaporation was 30.9 inches in depth from the water surface. Records of stream temperature below Farrell, taken during 1909 showed an average during these months 23.4 degrees hotter than the air, so that the evaporation and consequent reduction in volume, from this sluggish stream, was considerable. Increasing the flow in the river by the proposed reservoir would prevent the present rise in temperature and consequent loss through evaporation, effecting the conservation of the water now being lost in this way.

The water of the Shenango river is used principally for cooling purposes by the numerous steel companies. Each blast furnace, of which there are about a score in the valley, requires from three to five million gallons per day, depending on the size of the furnace and upon the temperature of the water. The plate and wire mills also use large quantities for cooling. For all the purposes, it has been estimated that a steel plant will use about 30,000 gallons of water per day for each ton of output. The colder the water the greater is its efficiency for cooling and the greater is the life of the equipment, hence it is essential, particularly if the available volume is small, to have its temperature low. Not only is the water supply to these works extremely limited in summer, but its temperature for months at a time has been found to remain above ninety degrees Fahrenheit.

The temperature of the air and of the water at Sharon and New Castle has been observed for some time and the results show the effect of the use of the water, by the steel works, upon its temperature. Under normal conditions, in this vicinity, the water in the flowing streams remains cooler than the average temperature of the air, but the records show that after being used at Sharon and Farrel it averaged during the year 1910, 16.3 degrees hotter than the air, as shown by Table No. 15, the maximum monthly excess being 36.4 degrees:

TABLE 15.

Monthly Mean Temperature of Air and River Water Below Farrell, in 1910.

Month.	Temperature of water.	Temperature of air.	Increase—water over air.
	deg.	deg.	deg.
January,	44	25.4	18.6
February,	45	22.5	22.5
March,	53	43.6	9.4
April,	62	49.6	12.4
May,	70	54.6	15.4
June,	80	63.8	16.2
July,	89	71.5	17.5
August,	104	67.6	36.4
September,	79	63.6	15.4
October,	64	53.2	10.8
November,	42	35.2	6.8
December,	38	23.6	14.4
Average,	64.2	47.9	16.3

The daily maximum temperature of the water reached 140 degrees, and the cooling effected by such water was necessarily small. It is this water that passes down the river to Wheatland and West Middlesex and thence to New Castle, to be used for municipal and industrial purposes, cooling somewhat, however, before reaching that point and also losing volume through evaporation. The largest mills at New Castle are below the junction with Neshannock creek, the water from which increases the volume and reduces the temperature. The New Castle water works intake is, however, above the mouth of Neshannock creek.

At New Castle the water is again heated by reuse, the resultant temperatures being greated than at Sharon during the midsummer months. In August, September, October and November, when the flow is low, the greatest rise in temperature of the water over that of the air takes place, the maximum, in 1909, being, in October, 17 degrees and in 1910, in August, 15.8 degrees. At New Castle it was possible to determine the actual increase in the temperature of the water as it passed through the industrial district, as illustrated by the following table:

TABLE NO. 16.

Monthly Mean Temperature of Shenango River Water at Upper and Lower Ends of Industrial District, New Castle, Penna.

1909. Month.	Temperature above mills.	Temperature below mills.	Rise.
	deg.	deg.	deg.
March,	34.5	45.1	10.6
April,	47.0	52.5	5.5
May,	58.5	63.5	5.0
June,	69.0	76.0	7.0
July,	74.5	83.5	9.0
August,	80.5	92.2	11.7
September,	80.0	91.0	11.0
October,	72.5	80.5	8.0
November,	59.3	64.5	5.2
December,	38.5	45.0	6.5
Average,	61.48	69.38	7.95
1910.			
January,	32.0	39.5	7.5
February,	29.3	37.2	7.9
March,	39.0	45.3	6.3
April,	51.3	56.6	5.3
May,	61.3	66.8	5.5
June,	72.4	80.3	7.9
July,	85.8	100.8	15.0
August,	95.7	117.5	21.8
September,	76.9	86.6	9.7
October,	59.4	64.6	5.2
November,	37.2	43.9	6.7
December,	29.2	37.1	7.9
Average,	55.8	64.69	8.89

This table shows an average rise of temperature of 7.95 degrees in 1909 and 8.89 degrees in 1910, with a maximum monthly mean rise in August, 1910, of 21.8 degrees, when the temperature of the water below the mills was 117.5 degrees; on individual days the rise was often much greater, the maximum increase being nearly 50 degrees Fahrenheit.

PROPOSED PYMATUNING DAM.

In order to obtain sufficient storage area to reduce the fluctuation of the surface of the reservoir and to maintain a water level such as would not require the purchase of the more valuable land, it was determined that the proposed dam should be placed as far downstream as possible. In the vicinity of Turnerville the hills on both sides of the valley converge to form a narrower valley than above that point and it was deemed advisable to locate the dam in this section. Detailed survey was made, extending northward about one-half mile from the Turnerville Road and entirely across the valley. Several possible dam sites were chosen from this survey and that considered best was selected for further study. Borings were made across the valley, penetrating to rock on the western side, while on the east and in the center they went down 50 to 60 feet without finding rock.

The substratum that fills the preglacial gorge at the Turnerville dam site consists of an impervious deposit of fine sand and clay, that will serve for the foundation of a dam of the type and height proposed. After penetrating a short distance below the surface the strata are generally of an extremely fine clay, and it has been noted that whenever gravel or sand strata were encountered, there was a large percentage of clay consolidated with and filling its voids, resulting in a probably impervious material. Additional borings should be made prior to the final choice of a dam site and before fixing minor details of construction. The rock outcrop in the run immediately upstream from the dam, indicates, together with the test borings, that a firm and solid foundation favorable for a concrete wasteway and regulation works is obtainable.

The type of dam considered in the preliminary design, is an earth embankment, with flat slopes, filling the present valley to an average height of 27 feet, combined with a concrete spillway, dam and channel founded on rock at the west end of the dam. The embankment would be constructed of earth, placed in layers and rolled, material being available close at hand, to make a tight structure.

The spillway has been given a width of 250 feet, permitting a discharge capacity more than that of the shorter dams at Jamestown and Greenville, the latter being below the junction of the Little Shenango and the Shenango rivers, where the drainage area is more than double that at the dam site. In addition, two regulating gates, 20 feet wide, are provided, together with a 96-inch blow-off and regulating pipe.

Rainfall at the rate of eight inches in 48 hours, which is in excess of that which has been known to occur, would raise the level of the reservoir but 2.0 feet, with a constantly increasing flow, at the spillway, which is designed to discharge at the maximum rate of 230 second feet per square mile of watershed. As the flow at Sharon, coming from the rest of the watershed, falls below the required 450 second feet, the gates will be opened to allow of the discharge of sufficient water to make up the deficiency, and vice versa when the natural run-off at Sharon increases, the gates will be closed.

Woodland near Westford.

Dam Site Looking Upstream from Turnerville Bridge.

EVAPORATION.

To determine the loss in evaporation by substituting the water area for a land area, data was secured at and in the vicinity of Linesville. From the first to June to the first of October, 1912, this information was gathered by observing the evaporation from three tanks; one at an elevation of approximately 1,020 feet, in Linesville borough; one at elevation 1,006, in the wooded swamp, and another at this elevation in the onion fields, which represent the average conditions of the cleared swamp area. It was found that the evaporation from the cleared area of the swamp did not differ materially from that of the observations collected from the tank in the borough, but that the tank in the woods had less evaporation, due primarily to the lower temperature of the air and water in the woods and the partial shading of the sun's rays and protection from the winds. A summary of the results of the evaporation that would occur from a water area under the climatic conditions at the reservoir site is as follows:

Month:	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Inches:	0.75	0.85	1.35	2.35	3.50	4.35	4.70	4.30	3.25	2.50	1.80	1.20	30.9

As the average climatic conditions at Greenville, for a period of eighteen years, correspond with those of 1912, the mean evaporation is probably close to that given.

It has been determined from actual stream measurements that there is a loss of 21 inches of rainfall in an average year, due to evaporation from land surface, absorption by plants, seepage, etc., in this locality, the balance of the rainfall being furnished, in varying amounts, to the Shenango river. By creating a lake from which an evaporation of 30.9 inches would result in an average year, there is a loss of 9.9 inches to be added to the 21 inches now occurring from the area which would be submerged, and in determining the storage required for regulation at Sharon, this has been allowed for.

RELATION BETWEEN RAINFALL AND RUN-OFF.

The monthly mean rainfall of 21 stations lying in or adjacent to the Shenango watershed above Sharon, has been collected and shown in Table No. 17, from 1878 to date, and the mean monthly and mean annual precipitation was determined therefrom for the contributary area above Sharon, as given in Table No. 18. Daily observation of stream flow, from 1909 to date, determined from 60 discharge measurements .corresponding to a wide range of gage heights, have been made at Sharon, and from these the relation between rainfall and run-off has been formulated, to equate the ranifall data previous to 1910 to equivalent run-off of the Shenango river at Sharon. Due regard has been paid to the variable run-offs to be expected from the erratic rainfalls that may occur in the same month during a number of years. The resulting monthly mean run-off has been calculated on a sliding scale, dependent on the variable rainfall and soil conditions for that month.

The accumulated run-off, showing the total yield for the watershed, was expressed graphically to illustrate the behavior of the stream from 1878 to 1912 and the periods including the lowest flows were subjected to a preliminary investigation. This demonstrated that the periods from 1893 to 1899 and from 1904 to date, represented the most exacting conditions which the reservoir would have to regulate and that the critical period was the extreme dry years of 1909-1910, which were preceded and followed by years representing the average conditions. Therefore, 1904 to 1912 has been subjected to a detailed study and the daily discharge for this period at Sharon tabulated, the time and amount of deficiency in stream flow at Sharon being determined and the amount of storage required above the dam site at Turnerville estimated. If the reservoir was built, one-sixth of the watershed above the dam site would be converted into water surface, the rain falling upon which would yield 100 per cent. run-off. This source of increased yield has not been considered in the computations, but provides a factor of safety in insuring an adequate supply.

To determine if sufficient water could be depended upon, from the drainage area above Turnerville, to furnish the amount of storage estimated as necessary for the regulation of the Shenango river, the daily run-off at Turnerville from 1904 to 1912 was estimated. The capacities of the reservoir at each foot in depth were also calculated, from the topographical surveys made, which permitted of fixing the height of the proposed dam. In selecting this the variable storage required in wet and dry years, the desirability of keeping the swamp lands covered at all times and utilizing as much of this and as little improved land as possible, were used as factors.

The flow line decided on was at an elevation of 1008 above mean sea level and the calculated fluctuations in the reservoir in May, 1904, are to be found in Table No. 19.

The mean daily discharge in cubic feet per second of the Shenango river at Sharon, determined by the stream measurements and referred to the Chestnut street gage, are given in tables Nos. 20 to 23, inclusive, and the estimated monthly discharge in Table No. 24. The mean daily discharge at Turnerville is given from February 1st, 1912, in table No. 25 and the monthly discharge data in table No. 26.

TABLE 17.

STATIONS USED TO DETERMINE MEAN PRECIPITATION FOR WATERSHED ABOVE SHARON, PA., FOR YEARS 1878 TO 1912.

Year.	Stations.
1878,...	Erie, Franklin, *Little Mountain, New Castle.
1879,...	Erie, Franklin, *Little Mountain, New Castle.
1880,...	Erie, Franklin, *Little Mountain, New Castle.
1881,...	Erie, Franklin, *Little Mountain, New Castle.
1882,...	Erie, Franklin.
1883,...	Erie, Franklin, *Warren.
1884,...	Erie, Franklin, *Warren, *Lordstown.
1885,...	Erie, Franklin, *Warren, *Lordstown.
1886,...	Erie, Franklin, Corry, *Lordstown, *Youngstown.
1887,...	Erie, Franklin, Corry, *Jefferson, *Youngstown.
1888,...	Erie, Franklin, Corry, *Jefferson, *Youngstown, New Castle, Greenville, Meadville, *Lordstown.
1889,...	Erie, Franklin, Corry, *Jefferson, *Youngstown, New Castle, Greenville, Meadville, *Lordstown, *Warren, *Orangeville.
1890,...	Erie, Franklin, Corry, *Orangeville, *Youngstown, New Castle, Greenville, Meadville, *Lordstown, *Warren.
1891,...	Erie, *Perry, Corry, *Orangeville, *Youngstown, New Castle, *Lordstown.
1892,...	Erie, *Perry, Corry, *Orangeville, *Youngstown, New Castle, *Lordstown, Saegerstown, *Astabula.
1893,...	Erie, *Colebrook, *Orangeville, *Hillhouse, *Warren, Meadville, Saegerstown, *Ashtabula.
1894,...	Erie, *Colebrook, *Orangeville, *Bissels, *Hillhouse, *Warren, Greenville, Saegerstown, *Ashtabula, *Auburn, *Youngstown, *Lordstown, *Perry.
1895,...	Erie, *Colebrook, *Orangeville, Saegerstown, *Ashtabula.
1896,...	Erie, *Colebrook, *Orangeville, Saegerstown, *Ashtabula.
1897,...	Erie, *Colebrook, *Orangeville, Saegerstown, *Ashtabula, Greenville.
1898,...	Erie, *Hillhouse, *Orangeville, Saegerstown, *Ashtabula, Greenville, *Perry.
1899,...	Erie, *Hillhouse, *Orangeville, Saegerstown, *Ashtabula, *Colebrook, *Perry
1900,...	Erie, *Hillhouse, *Orangeville, Saegerstown, *Ashtabula, *Colebrook, *Perry.
1901,...	Erie, *Hillhouse, *Orangeville, Saegerstown, *Colebrook.
1902,...	Erie, *Hillhouse, *Orangeville, Saegerstown, *Colebrook.
1903,...	Erie, *Hillhouse, *Orangeville, Saegerstown, Greenville.
1904,...	Erie, *Hillhouse, *Orangeville, Saegerstown, Greenville.
1905,...	Erie, *Hillhouse, *Orangeville, Saegerstown, Greenville, *Colebrook.
1906,...	Erie, *Hillhouse, *Orangeville, Saegerstown, Greenville.
1907,...	Erie, *Hillhouse, *Colebrook, Saegerstown, Greenville.
1908,...	Erie, *Hillhouse, *Colebrook, Saegerstown, Greenville.
1909,...	Erie, *Hillhouse, Skidmore, Saegerstown, Greenville, *Youngstown, Grove City, *Warren, Franklin.
1910,...	Erie, *Hillhouse, Skidmore, Saegerstown, Greenville, *Youngstown, Grove City, *Warren, Franklin.
1911,...	Erie, *Hillhouse, Skidmore, Saegerstown, Greenville, *Youngstown, Grove City, *Warren, Franklin.
1912,...	Erie, Sharon, Skidmore, Saegerstown, Greenville, *Youngstown, Grove City, *Warren, Franklin, Linesville, Turnerville.

*Denotes stations in Ohio.

TABLE NO. 20.

Mean Daily Discharge, in Second-Feet, of Shenango River at Sharon For 1909.

Day.	August.	September.	October.
1,	75	46	27
2,	70	46	27
3,	70	33	27
4,	54	63	28
5,	46	46	28
6,	46	37	27
7,	46	37	28
8,	46	33	30
9,	46	37	30
10,	46	46	28
11,	46	41	33
12,	44	46	33
13,	41	33	33
14,	41	33	37
15,	40	33	37
16,	44	28	33
17,	37	28	37
18,	41	28	33
19,	63	30	37
20,	44	30	37
21,	46	28	41
22,	46	28	41
23,	49	28	33
24,	46	30	33
25,	45	30	37
26,	49	30	37
27,	45	28	33
28,	46	28	33
29,	46	27	46
30,	46	28	46
31,	46	....	46

TABLE NO. 21.

Mean Daily Discharge in Second-Feet of Shenango River at Sharon For 1910.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	75	885	9,320	190	1,010	310	46	37	23	63	248	935
2,	87	773	13,600	177	1,070	411	46	37	27	46	278	890
3,	100	783	12,300	177	1,210	612	58	37	46	46	376	792
4,	164	1,040	10,600	310	2,190	792	63	37	138	46	376	765
5,	190	1,160	9,320	590	2,280	704	63	37	75	54	343	700
6,	190	990	8,930	548	1,800	722	75	37	190	448	326	655
7,	190	816	7,370	506	1,090	612	87	34	164	678	294	646
8,	190	655	7,570	527	840	486	87	30	138	527	233	590
9,	233	590	3,000	527	612	360	63	30	87	448	218	486
10,	233	523	1,760	411	486	310	60	30	63	278	248	376
11,	218	411	1,220	310	360	278	54	30	37	248	569	376
12,	204	411	1,160	263	294	245	46	27	46	218	940	376
13,	190	376	1,120	218	278	278	138	27	63	190	1,090	360
14,	190	336	1,070	204	278	248	112	27	61	164	816	343
15,	185	293	664	164	233	218	112	27	37	138	1,240	326
16,	180	448	595	164	190	204	63	27	46	112	1,150	310
17,	177	350	569	151	164	190	63	27	46	87	1,150	278
18,	745	390	527	138	233	218	63	30	30	87	965	278
19,	2,230	890	486	164	177	177	46	27	22	75	865	278
20,	2,470	890	486	190	177	138	37	27	20	63	788	248
21,	2,380	816	448	326	204	100	37	27	20	54	722	326
22,	2,740	950	467	326	506	112	39	27	20	87	678	343
23,	2,140	1,000	448	310	700	112	42	27	25	75	655	376
24,	1,670	890	411	307	506	75	44	27	218	87	792	310
25,	1,335	840	376	1,040	360	63	46	26	310	112	1,270	486
26,	1,200	722	360	2,630	360	75	46	27	190	190	1,340	700
27,	1,300	915	326	1,720	294	46	46	26	138	248	1,150	792
28,	1,480	5,240	278	1,650	278	37	37	25	138	218	1,090	915
29,	1,350	......	263	1,210	278	37	37	27	112	248	1,060	3,030
30,	1,120	......	218	965	233	46	37	25	87	263	1,040	4,370
31,	915	......	204	......	294	......	37	25	......	278	......	5,340

TABLE NO. 22.

Mean Daily Discharge in Second-Feet of Shenango River at Sharon For 1911.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, ...	3,535	1,210	768	1,204	965	190	143	33	153	5,843	278	646
2, ...	4,440	1,095	655	1,015	990	190	125	32	194	5,169	535	612
3, ...	5,986	880	569	890	840	138	125	35	263	3,032	486	535
4, ...	2,790	840	482	802	840	138	75	58	201	1,808	535	502
5, ...	2,100	745	376	1,856	745	87	33	120	201	1,596	655	433
6, ...	1,435	655	369	1,896	612	75	30	58	210	1,198	655	383
7, ...	1,106	655	393	1,210	506	68	30	41	218	2,575	1,210	397
8, ...	980	655	343	1,015	310	63	28	34	177	1,685	1,335	463
9, ...	1,078	612	343	925	278	54	25	35	221	1,046	1,010	629
10, ...	745	612	486	850	278	31	33	34	294	930	866	1,835
11, ...	754	448	655	722	278	27	204	31	360	890	840	1,045
12, ...	3,270	467	569	722	248	117	100	30	260	778	816	1,400
13, ...	4,376	486	700	700	190	233	92	30	177	705	1,198	3,684
14, ...	4,780	1,335	677	990	190	143	56	29	143	569	925	4,104
15, ...	7,491	3,140	548	1,095	164	100	39	29	7,759	467	792	4,248
16, ...	6,049	2,627	527	826	164	63	28	31	12,908	426	821	3,861
17, ...	2,001	2,790	486	802	164	51	63	39	7,697	369	745	2,533
18, ...	1,380	3,670	655	664	190	41	30	87	2,366	4,024	2,346	1,800
19, ...	1,051	3,387	935	722	218	37	28	100	1,400	4,280	2,669	1,296
20, ...	754	1,840	950	1,610	218	37	27	63	1,073	1,965	1,760	1,040
21, ...	656	1,387	326	1,150	248	36	27	32	830	1,784	1,730	811
22, ...	548	1,084	655	1,965	177	30	30	32	616	1,264	1,367	781
23, ...	429	792	830	2,422	190	28	30	30	433	1,139	1,096	1,270
24, ...	326	700	718	1,367	190	28	58	46	365	1,477	1,062	1,270
25, ...	294	780	569	965	218	33	54	56	297	696	1,180	1,695
26, ...	326	1,005	527	722	188	34	46	61	263	552	925	1,078
27, ...	340	1,180	548	655	138	233	46	100	207	478	890	1,400
28, ...	4,312	840	975	612	87	1,122	41	463	275	426	840	1,400
29, ...	5,112	......	840	840	46	343	41	2,790	960	397	890	840
30, ...	4,328	......	940	709	27	177	35	1,328	1,200	356	768	845
31, ...	2,900	......	1,328	......	27	......	34	515	......	369	......	1,662

TABLE NO. 23.

Mean Daily Discharge in Second-Feet of Shenango River at Sharon For 1912.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, ...	3,150	816	1,770	4,440	2,270	230	60	87	655	169	700	218
2, ...	1,950	745	1,400	6,050	1,500	215	49	87	1,720	138	590	260
3, ...	1,335	731	1,070	7,350	1,120	297	49	97	1,000	128	527	394
4, ...	1,070	700	845	5,640	895	310	107	85	816	112	467	433
5, ...	573	687	673	3,520	612	230	60	68	467	112	441	376
6, ...	480	569	544	2,900	486	233	46	92	393	87	397	1,470
7, ...	515	463	510	2,630	433	248	61	75	444	77	478	1,484
8, ...	506	411	502	3,960	356	224	41	73	330	68	920	1,056
9, ...	506	376	637	2,520	330	185	44	87	283	82	773	1,070
10, ...	594	350	655	1,830	310	138	75	187	204	278	745	826
11, ...	448	326	511	1,340	288	128	110	204	190	1,680	778	691
12, ...	376	310	486	1,020	317	110	218	412	169	890	700	486
13, ...	320	310	634	840	397	97	143	218	133	591	616	263
14, ...	318	278	629	722	441	82	102	177	112	429	561	326
15, ...	300	257	1,780	3,910	475	82	60	185	104	310	519	317
16, ...	310	215	2,780	3,450	544	426	92	112	77	248	519	333
17, ...	298	207	3,670	2,060	750	535	164	92	87	174	486	359
18, ...	336	221	4,780	1,760	773	404	263	73	125	143	448	408
19, ...	688	267	6,520	1,280	696	278	117	100	107	441	426	411
20, ...	830	608	5,950	975	683	201	54	185	112	890	376	429
21, ...	760	773	5,110	773	511	148	323	107	112	629	376	373
22, ...	696	885	3,780	636	397	133	257	104	102	544	336	248
23, ...	600	754	2,790	655	320	112	154	87	260	3,640	294	248
24, ...	688	682	4,610	551	251	100	732	107	850	6,810	278	310
25, ...	612	655	4,040	486	230	102	620	87	612	6,390	272	248
26, ...	595	2,230	2,770	404	190	112	380	1,960	429	5,380	251	218
27, ...	486	3,880	2,360	383	164	92	263	1,810	370	3,270	248	224
28, ...	459	3,890	2,690	360	169	82	204	812	291	2,010	233	196
29, ...	400	2,370	5,250	1,220	164	80	177	673	248	1,400	218	154
30, ...	759	......	7,390	3,820	193	63	138	642	190	1,040	212	437
31, ...	910	......	5,950	......	212	......	112	865	......	830	......	1,575

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TABLE NO. 24.

Estimated Monthly Discharge, Shenango River, at Sharon.

(Drainage area, 605 square miles.)

Month.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1909.					
August,	75	37	48.3	0.080	0.092
September,	63	27	34.6	0.057	0.064
October,	46	27	34.1	0.056	0.065
1910.					
January,	2,740	75	844	1.395	1.608
February,	5,240	298	889	1.469	1.530
March,	13,600	204	3,080	5.090	5.868
April,	2,630	138	547	0.904	1.008
May,	2,280	164	612	1.012	1.166
June,	792	37	274	0.453	0.505
July,	138	37	59	0.098	0.113
August,	37	25	29	0.049	0.057
September,	310	20	87	0.144	0.160
October,	678	46	190	0.313	0.361
November,	1,340	218	742	1.226	1.368
December,	5,340	248	886	1.465	1.689
The year,	13,600	20	687	1.135	15.433
1911.					
January,	7,491	294	2,441	4.035	4.652
February,	3,670	448	1,283	2.120	2.208
March,	1,328	343	653	1.079	1.244
April,	2,422	612	1,064	1.759	1.963
May,	990	27	318	0.526	0.607
June,	1,122	27	132	0.218	0.243
July,	204	25	57	0.094	0.108
August,	2,790	28	206	0.341	0.393
September,	12,908	143	1,401	2.315	2.583
October,	5,843	356	1,558	2.575	2.969
November,	2,669	278	1,041	1.721	1.920
December,	4,248	383	1,395	2.306	2.659
The year,	12,908	25	962	1.591	21.549
1912.					
January,	3,150	298	703	1.163	1.341
February,	3,890	207	861	1.423	1.534
March,	7,390	486	2,680	4.430	5.107
April,	7,350	360	2,250	3.718	4.148
May,	2,270	164	530	0.876	1.010
June,	535	63	189	0.313	0.349
July,	732	41	170	0.281	0.324
August,	1,960	68	319	0.528	0.609
September,	1,720	77	365	0.603	0.673
October,	6,810	68	1,258	2.079	2.397
November,	920	212	473	0.781	0.871
December,	1,575	154	524	0.866	0.998
The year,	7,390	41	860	1.422	19.361

TABLE NO. 25.

Mean Daily Discharge in Sec.-Feet of Shenango River at Turnerville for 1912.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	......	325	1,150	1,447	485	85	12	12	108	35	260	64
2,	......	348	883	1,447	542	91	12	16	96	31	229	91
3,	......	385	567	1,485	362	108	12	16	91	26	200	126
4,	......	426	406	1,278	236	85	12	16	70	22	187	120
5,	......	389	305	1,235	162	102	12	14	44	22	174	162
6,	......	312	245	1,112	132	132	12	14	40	20	168	422
7,	......	208	190	850	120	126	12	12	40	16	200	372
8,	......	175	176	985	108	96	12	12	35	14	252	442
9,	......	145	190	970	108	70	10	12	26	14	229	392
10,	......	120	172	642	102	44	10	20	22	20	292	268
11,	......	102	155	442	97	81	10	26	20	40	316	222
12,	......	92	150	330	102	22	10	31	16	44	300	187
13,	......	87	162	264	102	22	12	35	14	40	268	156
14,	......	76	235	221	108	22	12	31	14	40	229	138
15,	......	73	403	491	132	22	14	22	12	31	200	114
16,	......	66	810	791	174	22	14	16	14	22	200	114
17,	......	56	1,360	925	292	40	16	12	14	22	187	126
18,	......	50	1,977	580	308	49	12	12	31	20	174	126
19,	......	56	2,074	402	308	44	10	12	31	120	180	138
20,	......	78	1,775	316	260	35	9	12	22	126	180	126
21.	......	110	1,598	260	193	22	9	12	22	102	168	168
22.	......	140	1,285	207	144	22	12	12	20	96	144	132
23.	......	136	1,132	180	120	22	12	12	31	1,296	120	138
24,	......	136	1,160	162	102	20	14	14	102	1,850	108	120
25,	......	140	1,085	144	80	20	44	14	80	2,040	102	91
26,	......	223	1,085	132	64	20	40	16	70	1,685	85	60
27,	......	900	850	120	49	16	31	102	70	1,225	80	60
28.	......	957	835	108	40	14	16	102	64	910	75	45
29,	......	1,070	1,232	114	49	14	14	108	54	617	70	45
30,	......	......	1,723	432	69	14	12	114	40	422	64	60
31,	......	......	1,764	......	75	......	14	114	......	325	......	370

TABLE NO. 26.

Estimated Monthly Discharge, Shenango River, at Turnerville For 1912.

(Drainage area, 150 square miles.)

Month.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January,	....	....	....	....	....
February,	1,070	50	254	1.697	1.830
March,	2,074	150	875	5.833	6.725
April,	1,485	108	602	4.016	4.481
May,	542	40	169	1.124	1.296
June,	132	14	48	0.318	0.355
July,	44	9	15	0.098	0.113
August,	114	12	32	0.210	0.242
September,	108	12	44	0.292	0.326
October,	2,040	14	364	2.428	2.800
November,	316	64	181	1.209	1.349
December,	442	45	168	1.117	1.288
Eleven months,	2,074	9	223	1.667	20.807

The surface area and amount of water that would be impounded in the proposed reservoir, computed from the maps of the survey, are shown at intervals of two feet in height, between the elevations of 980 and 1,018 feet above sea level, in the following table:

TABLE NO. 27.

Calculated Surface Area and Capacities of the Proposed Pymatuning Reservoir.

Elevation Above Sea Level.	Surface Area in Acres.	Capacity of Reservoir in Million Cubic Feet.
980	77	10
982	256	64
984	608	164
986	1,158	301
988	2,086	485
990	3,252	736
992	4,557	1,054
994	5,920	1,496
996	7,315	2,066
998	8,730	2,791
1,000	10,195	3,663
1,002	11,558	4,628
1,004	12,979	5,696
1,006	14,368	6,875
1,008	15,808	8,182
1,010	17,286	9,632
1,012	18,637	11,199
1,014	20,083	12,746
1,016	21,498	14,318·
1,018	22,912	15,891

NOTE.—1 cu. ft. = 7.48 gallons.

EFFECT OF RESERVOIR ON SURROUNDING AGRICULTURAL LAND.

It is important to have the ground water, upon which deep rooted crops depend during the growing season, approach the surface within their reach. Raising the water level by a storage reservoir decreases the slope of the underground water, lessens its flow into the surface streams, and, consequently, raises the sub-soil water under the tillable land. The lowering of the water in the swamp by drainage would have the opposite effect.

The well data collected at the reservoir site gives information regarding the importance of the conserving power of Pymatuning Swamp. The change in the water level of forty-six wells, within and bordering on the reservoir site, was observed from February 1st to November 1st, 1912, and the data collected affords a fair indication of the existing conditions of the upper level of the underground water. The maximum observed fall in ground water was 9.97 feet, occurring from April 1st to August 1st; a mean fall for wells in the northern portion of the reservoir site was about 5.5 feet, from April 1st to October 1st. In general it was found that the subsoil water rose until April 1st, gradually falling until the crops were harvested on October 1st, when, in response to the autumn rains, the underground reservoir began to rise. The draught on ground storage in this vicinity usually begins about the middle of April, and, when

Typical Views of Onion Fields and Pasture Lands in Reservoir Site.

drawn down, unless the precipitation is largely in excess of the normal from June to August, the entire rainfall would be absorbed by the dry earth and plants and not increase the ground water. The excessive rainfalls that occur from May to September, when the ground water is at low stage, cause less violent floods than would result from equal precipitation in April or in October or November, when the sub-soil is saturated.

UNDERGROUND STORAGE.

The real storage now existing in the Pymatuning Swamp district, is mainly in the porous sands which extend around the shores of the swamp. The dense vegetation in the swamp retards run-off in the spring and raises the ground water level in the adjacent porous sand plains when the swamp lands are overflowed. This ground storage is released and maintains a flow in streams and ditches, tributary to the river north of Manning Bridge, long after Gravel run, McMichael creek and the brooks near the dam site have become practically dry.

During the summer months the vegetation in the swamp consumes water for the support of plant life, particularly in the district between Linesville and Hartstown, which is covered with a dense growth of weeds, rushes and brush, which, together with the increased evaporation, decreases the efficiency of the swamp as a stream regulator. The main benefit which the Shenango receives from the swamp is through its increased flow from the stored ground water and in retarding the spring flow during the freshet seasons. This retardation is materially increased in winter and early spring, by the fact that the dense evergreen growth in the swamp furnishes an efficient shading of the ice and snow, from the sun, thereby reducing the loss by evaporation.

SOIL IN DISTRICT ADJACENT TO RESERVOIR SITE.

According to the report of the United States Department of Agriculture on the Reconnoissance Soil Survey of Northwestern Pennsylvania, the soils of Crawford county occur under three classifications, known as Volusia, Wheeling and Genessee soils. The former are composed of glacial till, while the Wheeling and Genessee soils belong to the terrace and bottom land series. All of these soils are to be found within the limits or adjacent to the reservoir site.

The Volusia, or upland soil, was deposited at the recession of the ice sheet during the glacial period, and is in general, composed of silt loam, or of loam and clay of fine texture, but throughout the region covered by the Volusia soils, there are mixed deposits of detritus which rise as islands in the swamp, or as ridges on the higher ground. These deposits are evidenced by the broken topography near Penn Line, at Westford, and in the vicinity of the dam site, and also by hummocks and long sinous ridges near Linesville. The soil on the steep areas is stony, but in the flat tracts or on gentle slopes it is composed of loam and clay, in general having layers of six to eight inches of loam resting on a clay sub-soil. The prices of Volusia farm lands, in general, range from $15 to $50 per acre, a fairly representative value for the areas adjacent to the dam site being about $20 to $40 per acre, including farm improvements.

The Wheeling and Genessee soils are to be found in the lowest lands bordering on the Shenango river, and are sedimentary. The Wheeling soils are to be found west of Padan's creek and north of the Swamp Road and immediately south of Linesville borough. These soils, in general, occupy land above the limits of the proposed reservoir and are well drained and productive, although there is a tendency toward droughts and a rapid depletion of the ground water, by reason of the occurrence of underlying gravel beds. There are many desirable farms on the Wheeling soils, and, although the more sandy and porous lands are less productive, the more valuable lands are worth from $60 to $80 per acre, where well improved.

The Genessee soils are to be found in the alluvial bottom lands and the larger proportion of the land within the reservoir site belongs to this classification, being composed of sands or heavy clays. That which is not subject to inundation, is tilled to advantage and the periodically overflowed land is devoted to pasturage.

CLASSIFICATION AND VALUE OF LAND IN FLOODED AREA.

It is estimated that the reservoir, at spillway level, will inundate 24.7 square miles, or 15,808 acres, but in determining its cost it has been assumed that additional land above that level should be acquired to provide for the raising of the level by floods, and that the entire area below elevation 1010 should be purchased. Furthermore, it would not seem necessary that the taking line should follow all the irregularities of the shore line. At the upper end of the swamp, south of Linesville and north of Hartstown, the proposed water level crosses the dense swamp and, owing to the backwater effect in this area, it is proposed to acquire flowage rights, up to elevation 1012. Enclosed within the reservoir there will be several islands, cut off from shore communication, which, also, would be purchased. Thus the total area required for reservoir purposes amounts to 18,600 acres, divided as follows:

Land required in fee,	85.8 per cent. or	17,378 acres
Land released for flowage rights,	14.2 per cent. or	1,222 acres
Total,		18,600 acres

Views Showing the Better Class of Farms in Reservoir Site.

Of the 17,378 acres necessary to purchase, 51.7 per cent., or 8,993 acres, is swamp or partially overflowed land, the greater portion of which is inaccessible, except when the surface is frozen, and even then is attended with difficulty and often danger. The cultivated lands and onion fields comprise 13.9 per cent., or 2,413 acres, the balance of 5,972 acres, or 24.4 per cent., include wood, pasture and meadow lands. The swamp and dry lands may be further subdivided as follows:

Swamp and overflowed lands:		
Covered with woods and timber,	7,541 acres	
Covered with brush and burned timber,	872 "	
Open,	580 "	
		8,993 acres
Dry lands:		
Cultivated,	1,965 acres	
Onion fields,	448 "	
Woodland,	930 "	
Pasture, meadow and miscellaneous,	5,042 "	
		8,385 acres
Total,		17,378 acres

There are 115 buildings in and bordering on the proposed reservoir that would be affected, sub-divided as follows: 53 houses, 56 barns and six miscellaneous structures. It would not be necessary to destroy or acquire all of the buildings affected, 22 houses and 21 barns could be moved to higher ground on the same properties without depriving the owners of their homes. In general, the project does not involve the taking of the better portions of farms, although at the lower end of the reservoir it would be necessary to take entire farms situated in the flats bordering on the river.

A fair conception of the agricultural lands in this vicinity may be obtained from the 39th Report of the Secretary of Internal Affairs of Pennsylvania, for 1911, in which it is stated that of the total area of Crawford county, 87½ per cent. is devoted to farming, sub-divided as follows:

Total farm acreage,	580,411,	value,	$13,690,673
Buildings,		"	9,820,167
Total number of farms,	7,115		
Total,			$23,510,860
Improved acreage,	375,945	acres—56.7%	of entire county
Woodland acreage,	115,546	" —17.4%	" " "
Unimproved acreage,	88,920	" —13.4%	" " "
Total,	580,411	acres—87.5%	of entire county

The average Crawford county farm contains about 81.6 acres, of which 52.8 acres, or 64.7 per cent., are improved or under cultivation; the mean value, per acre, of the entire farms being $23.60 or $40.50 per acre, including buildings.

SWAMP DRAINAGE.

It has been proposed, from time to time, to drain the Pymatuning Swamp, by means of canals and ditches and to thus add 7,000 acres of land, now unproductive, to the producing area of the State. In prosecuting this survey, the Commission has advised itself regarding this feature and has become assured that, although it is possible to partially or perhaps wholly drain the surface water from this area, such is not the best use to make thereof; that the greatest benefit will accrue to the State by flooding rather than draining it.

Experience indicates that, in general, the slope available, limits the area that can be feasibly drained and reliable practice shows that the following slopes are necessary to maintain ditches for the corresponding areas:

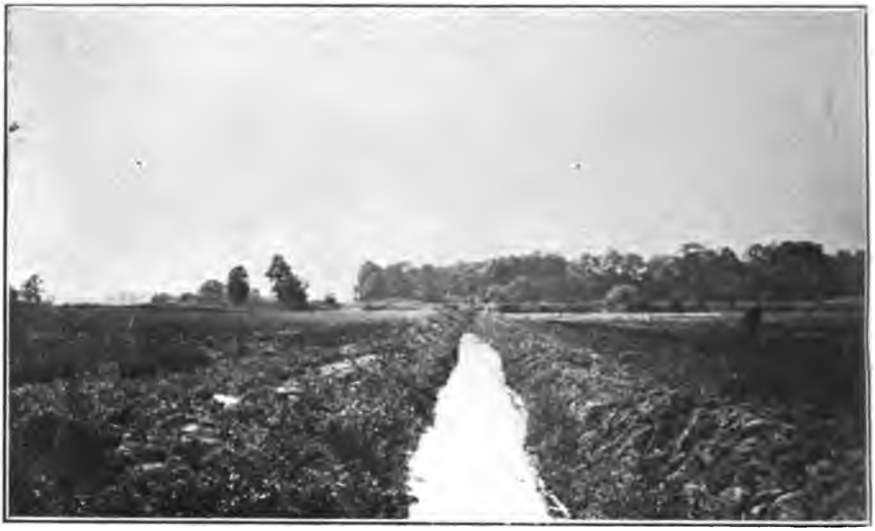
TABLE NO. 28.

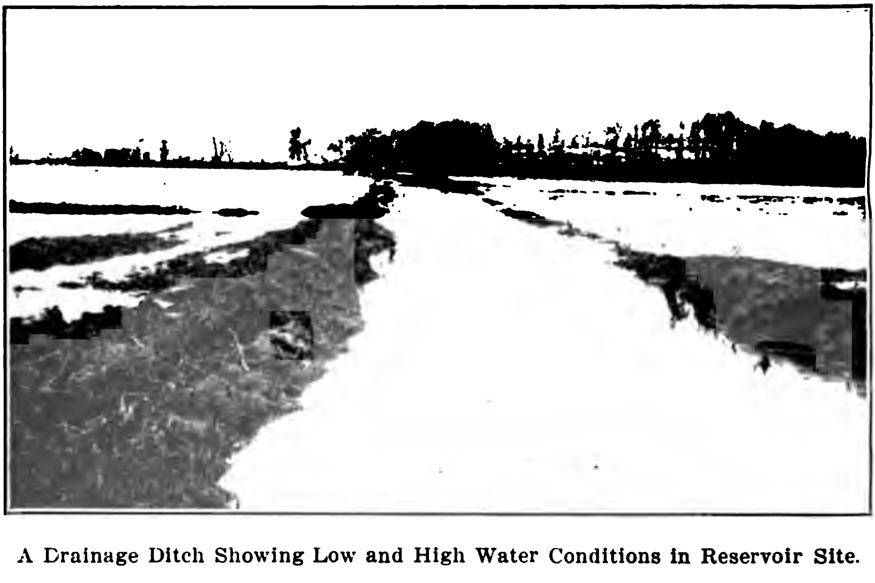
Slopes Required For Drainage Ditches.

Slope in feet per mile.	Area drained.	Result.
2.0 feet per mile,	28,000 acres,	Caused slight scour.
2.0 " " "	16—18,000 "	Self cleaning.
3.0 " " "	6— 7,000 "	" "
4.0 " " "	4,000 "	" "
5.0 " " "	2,000 "	" "
2.0 " " "	2,000 "	Two foot siltage.
1.5 " " "	2,000 "	Three foot siltage—efficiency destroyed.

The entire area above Pollock's Bridge was surveyed and the ditches and small streams existing throughout the swamp located and mapped with reference to the drainage problem, and the slope of the water surface noted. Several instances were found where the drains had silted up and become clogged with vegetation, which destroyed their effectiveness.

The area of the swamp above Pollock's Bridge is 6,900 acres, which would require a slope of 3.0 feet per mile to drain properly. It has been found that the slope for the first 3.78 miles above this bridge, to the railroad, is 1.72 feet per mile, and for the next 3.2 miles the fall is 3.6 feet per mile. Drainage ditches constructed between Pollock's Bridge and the railroad would not be self cleaning, but the territory above the railroad, to the corduroy road, might be drained by dredging the ditches yearly. Above the corduroy road, and well above the limits of the reservoir, there is a tract containing about 1,480 acres of swamp land, through which the stream falls from 4.0 to 5.2 feet per mile. It would be entirely feasible and practical to construct drainage ditches in this area that would be self cleaning and not require a yearly appropriation for maintenance.





A Drainage Ditch Showing Low and High Water Conditions in Reservoir Site.

From Manning Bridge downstream, to the Westford Bridge, the river has an average slope of but 1.3 feet per mile and from the latter point to Jamestown the slope reduces to 0.8 foot per mile. The effect of extensive drainage above Pollock's Bridge would be the formation of bars and ridges in the Shenango river and an increase in periodical overflows below Manning Bridge.

While the swamp can undoubtedly be ditched, it appears conclusive that a comprehensive drainage system cannot be maintained without a considerable yearly cost for maintenance. If the Pymatuning Swamp above Pollock's Bridge should be subjected to a comprehensive scheme of drainage, there would probably be an augmented dry weather flow for a year or so following such drainage, but at the expiration of this period the dry weather flow would be less than under present conditions.

PYMATUNING SWAMP AS A REGULATOR OF STREAM FLOW.

A study has been made from actual measurements in the swamp and along the Shenango river, to determine the percentage of flow from the swamp at times of flood and extreme dry flow, and from the data collected it has been demonstrated that in the flood of October 22nd to 29th, 1912, 32.7 per cent. of the flow at Sharon was contributed by the run-off from Pymatuning Swamp, as measured at Turnerville. During the period from October 30th to November 6th, while the river flood was receding, the swamp contributed 39.6 per cent. of the run-off, from which the conclusion is reached that, in as much as this percentage is in excess of the proportion of the drainage area at Turnerville to that at Sharon, by about 15 per cent., the flood water is retained in the swamp and is paid our gradually to the Shenango river below Turnerville, while the contributary streams below that point fell off more rapidly.

The dry periods, which occurred from July 1st to July 9th, August 1st to August 9th and August 17th to August 25th, furnish information bearing on the amount of water furnished from this swamp when the Shenango river, at Sharon, is at low flow. From this information it has been determined that when the river at Sharon had a discharge of 100 second-feet, the area above Turnerville contributed about 12 per cent., for a discharge of 50 second-feet, 26 per cent., and for a 40 second-foot discharge at Sharon, this area contributed 30 per cent., which was the lowest available point for direct measurement obtainable in the year 1912. Continuing the ratio, as observed from the information given above, and plotting a curve of percentage on that basis, it was found that when the flow at Sharon falls to 30 second-feet, this area would contribute about 35 per cent., and for a 20 second-foot flow at Sharon, about 43 per cent. comes from Turnerville. During the year 1912, 28.6 per cent. of the discharge at Sharon was furnished by the catchment area above the dam site at Turnerville, which is 3.8 per cent. in excess of the proportional drainage area. These investigations do not include the stream which issues from the swamp, in the vicinity of Hartstown and Adamsville, and drains into the Shenango river, through Crooked creek, and enters the main stream above the dam at Greenville.

The improvement in the slope and width of the channel of the Shenango river traversing Pymatuning Swamp would permit of a more rapid run-off and increase the flood flows at Sharon, for the reason that it would require a less interval of time for the water draining into Pymatuning Swamp to reach Sharon, and would allow the run-off from the main river and tributary streams to culminate more nearly at the same time. At present, as is shown by the records and observations taken from 1910 to date, there are two flood crests which occur at Sharon, one caused by the tributary streams below Greenville, and the other, coming later, due to the water from Pymatuning Swamp.

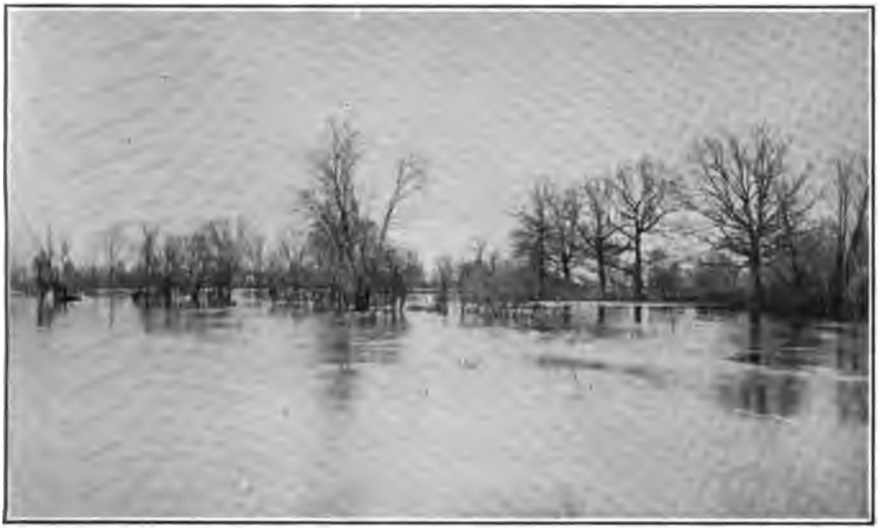
During the low periods, if the channel of the Shenango river above Manning Bridge were improved for drainage purposes, the waters held back in the swamp and sub-soil, would be depleted in a short time, causing a material decrease in the percentage which Pymatuning Swamp furnishes at present.

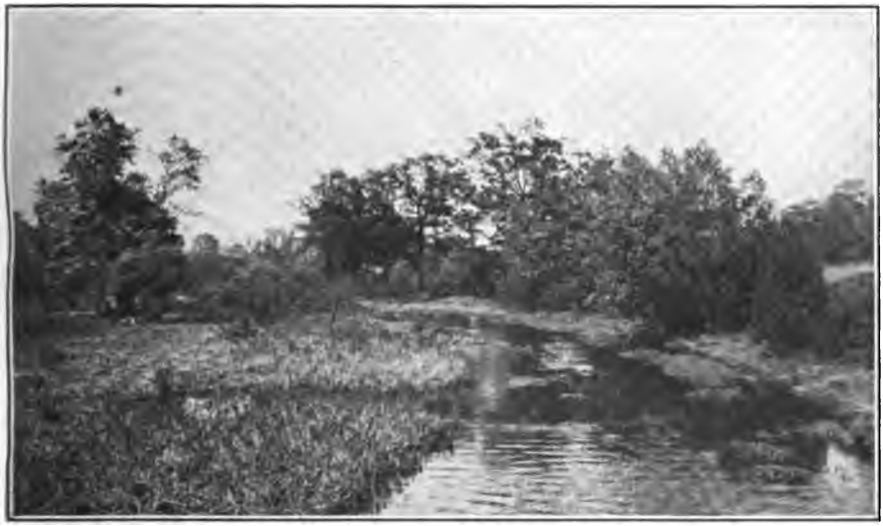
SHORE AND RESERVOIR TREATMENT.

It is proposed to remove all trees and brush from the entire reservoir and to burn that which is not salable. Around the shores and within the limits of fluctuation of the reservoir and three feet above the normal level thereof, in addition to the treatment above described, it is proposed to pull the stumps and carefully clear up and burn the vegetable matter. The subsequent wave action will erode and overturn the soil on the slopes of the wider portions and experience has taught that this action results in creating sandy and gravelly shores, similar to those formed on natural ponds. Conneaut Lake has a rise and fall of four feet; Chautauqua Lake, six feet; Tupper Lake, in the Adirondacks, eight feet, and they have beautiful shores and are utilized as health resorts.

CONDITIONS AFFECTING SANITATION AT RESERVOIR SITE.

It was determined to place the flow line of the proposed reservoir higher than that actually required to obtain the necessary storage, or, in other words, to create a reservoir larger than would be exhausted every year. Such a reservoir would have small fluctuations between high and low water and, with the greater depth, it would never be necessary to uncover the present swamp, while the risk of the reservoir becoming offensive would be avoided. This reservoir,





High and Low Water in Shenango River Upstream from Pollock's Bridge, Showing Periodic Overflow.

Swamp Road West of Linesville and Overflow at Padan Creek Bridge.

with its improved shore line, its beaches, and the regulating sluiceway so devised that the water could in no way be drawn so low as to uncover the swamp, would afford an added attraction to the nearby villages.

During the spring run-off, and at times when there are unusually heavy rainfalls, the low land, which is proposed for a reservoir site, is subject to periodic overflow and data have been gathered at several points to show the fluctuation in the floods which cover over 50 per cent. of the reservoir contemplated. During such periods roads in the vicinity of and above Manning Bridge are frequently overflowed.

The maximum draft from the proposed reservoir during 1912 would have been 3.7 feet, occurring at the end of September, while between March 1st and June 1st, 1912, there were fluctuations in the overflows at the Swamp Road Bridge, over Padan creek, of five feet, and about the same amount at the end of October, being 1.3 feet in excess of the variations that would have occurred in the surface of the proposed reservoir. The low land in the vicinity of the Pennsylvania Railroad, south of Linesville, was frequently flooded, between March 1st and June 1st, to a depth of six feet and at the end of October there was a rise of five feet, covering the swamp and cultivated lands. In the vicinity of the road across the swamp near Shermansville there was a rise and fall, for the first period mentioned, of 6.5 feet, and about six feet for the latter period, which is 2.5 feet to three feet more than would have occurred in the reservoir, the water rising to within two feet of the level at which it is proposed to hold the stored water. Whether a storage reservoir is sanitary and attractive, or unhealthy and unattractive, is mainly a question of expenditure and supervision and it is believed that the aesthetic and sanitary conditions resulting from this natural overflow are inferior to those which would follow the construction of the contemplated reservoir.

HIGHWAYS.

The creation of a lake of practically twenty-five square miles area and whose length is sixteen miles, will of necessity flood existing highways and cause a relocation of some and elevation of others. But this lake may become a transportation medium and, in such event, the fewer highways crossing it the better. The decision as to what roads shall be preserved will be a matter for those interested to decide, but for the purpose of estimating cost, changes in eleven miles of highway have received attention and an effort has been made to disturb present conditions to as small extent as possible. It is believed that modifications in the reconstruction of highways may materially reduce this important item in the cost of the proposed reservoir. All of the relocated roads are estimated as having a width of twenty to twenty-four feet, the roadway being sufficiently above the full water surface to withstand wave action, the sides and embankments having flat slopes, riprapped.

RAILROADS.

If the reservoir is constructed with the flow line indicated, it will be necessary to elevate the tracks of the Erie and Pittsburgh Division of the Pennsylvania Railroad for 9,000 feet, but this will be advantageous, as it eliminates grades descending to and ascending from the swamp. In estimating the cost of this work the unit prices used are those given by railroad officials.

LAKE ERIE-OHIO RIVER SHIP CANAL.

It has been suggested that the Pymatuning Swamp be used as a storage basin to supply the summit level of the proposed Lake Erie-Ohio River Ship Canal, whose projected line is from near Ashtabula, Ohio, on Lake Erie, to the Mahoning river; down that stream and the Beaver river and up the Ohio river to Pittsburgh. It is said that the canal would require a storage of about ten billion cubic feet and that the water would be brought, by a feeder, from French creek, and stored in the swamp to be used as needed. It is considered that the utilization of Pymatuning Swamp for regulating the flow of the Shenango river need not interfere with the other use, as it would be practicable for the canal storage capacity to be obtained by raising the proposed Turnerville dam.

SUMMARY OF FIELD WORK.

The stadia work within the 1020 contour above the dam site was tied into the triangulation system, enclosing an area of 49.18 square miles and composed of a net work of forty stations, which, owing to the flat and wooded country, were located on barns and high cleared ground around the reservoir site. A base line was laid out along the Pennsylvania Railroad between Linesville and Espyville, having a triangulation station at each end, from which the system extended toward Hartstown and downstream to the stone monuments on the Ohio-Pennsylvania State Line, near Penn Line and Turnerville. The length of the base line was 4,404.938 feet, the average variation of the measurements from the mean length of the base line being 0.057 foot, equivalent to one foot in 14.8 miles. The triangulation system, as extended, was tied in near Turnerville to the stone monuments of the Ohio-Pennsylvania State Line, which are set one mile apart, the error of closure being 0.20 foot.

The stadia traverse lines of the topographical survey proper began and ended at these accurately located triangulation stations. The total length of traverse lines, aggregating 144 miles, covered an area of 39.2 square miles of the swamp and adjacent country; the average error in closure being one foot in 1,167 feet. These unavoidable errors were not allowed to accumulate and were adjusted between the triangulation stations, the average length of a traverse being about 2.5 miles. The average progress on stadia work, taking topography, was 1.80 miles per day, the maximum rate being 4.25 miles, and the average cost per mile being $17.32, or $63.75 per square mile.

Ninety-four miles of primary levels were run and 135 bench marks established, to determine the elevation of points above sea level in and about the reservoir site, for the purpose of furnishing convenient reference points to check the elevations as later determined by the topographical survey, and to have a reliable datum for the slopes in the river and for drainage studies. The system of levels is referred to a United States Geological Survey bench mark at Linesville, having an elevation of 1,049.759 feet above sea level, and the error in level circuits averaged one inch in sixteen miles.

Owing to the fact that a large portion of the swamp is inaccessible except when frozen, advantage was taken of the severe winter of 1912 to survey the swamp at that time, the temperature during working hours often falling to 18 and 20 degrees below zero. The township lines formed by the tortuous channel of the Shenango river, were traversed during this season and, so far as known, it is the first time these lines have been accurately surveyed and located.

Previous to this survey, 49 discharge measurements had been made at Sharon, extending from 1909 to 1912, to determine the flow of the Shenango river, all of which have been referred to the Chestnut Street gage. In addition to the above data, a series of reliable stream discharge measurements, 49 in number, were made by this survey during 1912, and new stations were established, as shown by the following table:

TABLE NO. 29.

Stream Gaging Stations.

Location.	Bridge.	Bridge.	Number of Measurements.
Sharon,	Shenango River,	Cinder Bridge,	4
Sharon,	Shenango River,	State Street Bridge,	4
Sharon,	Shenango River,	Mill Street Bridge,	2
Greenville,	Little Shenango,	Quaker Bridge,	7
	Shenango,	Main Street Bridge,	3
	Shenango,	Porter Bridge,	2
Turnerville,	Shenango,	Turner Bridge,	15
North Shenango,	Shenango,	Pollocks Bridge,	5
Pine,	Linesville creek,	P. R. R. Bridge No. 17,	4
North Shenango,	Shenango,	P. R. R. Bridge No. 18,	2
Pine,	Padan creek,	Padanaram Swamp Road Bridge,	1

For the purpose of keeping a record of the high and low water conditions along the river and throughout the swamp, 18 points were selected on the several bridges over the streams, the elevations of which were referred to the system of levels previously described. The following is a list showing the points at which records have been taken from February, 1912, to date.

TABLE NO. 30.

List of Gages For Observing Periodical Overflows.

Number.	Stream.	Location.	Miles above Turnerville.	Description.
1	Shenango, ...	Sadsbury, Blair Road Bridge, ...	18.37	Mark.
2	Shenango, ...	Sadsbury, B. & L. E. Trestle, ...	19.91	Mark.
3	Shenango, ...	North Shenango, Corduroy Road Bridge, ...	17.16	Mark.
4	Linesville creek,	Linesville, Erie Street Bridge, ...	17.22	Mark.
5	Linesville creek,	Linesville, Bundays Wier, ...	17.15	Staff gage.
6	Linesville creek,	Linesville, below Bundays Mill, ...	17.00	Wier.
7	Linesville creek,	Linesville, Bullistown Bridge, ...	16.50	Mark.
8	Linesville creek,	Linesville, P. R. R. Bridge No. 17, ...	15.62	Wier and mark.
9	Shenango, ...	North Shenango, P. R. R. Bridge No. 18, ...	15.18	Mark.
10	Padan creek, ...	Pine, Finley's Bridge, ...	16.10	Mark.
11	Padan creek, ...	Pine, Swamp Road Bridge, ...	13.02	Mark.
12	Shenango, ...	North Shenango, Pollocks Bridge, ...	11.40	Staff gage.
13	Shenango, ...	North Shenango, Manning Bridge, ...	9.69	Mark.
14	Shenango, ...	North Shenango, Andover Highway Bridge, ...	8.30	Mark.
15	Shenango, ...	North Shenango, Westford Highway Bridge, ..	4.15	Staff gage.
16	Shenango, ...	North Shenango, 2d Bridge above Turners, ...	2.61	Mark.
17	Shenango, ...	North Shenango, 1st bridge above Turners, ...	1.93	Mark.
18	Shenango, ...	North Shenango, Turnersville Bridge, ...	0.00	Staff and chain gage.

Below the dam site thirty-one points were selected throughout a distance of 65 miles, from the Turnerville Bridge to the Rainey Dam at Mahoningtown, all of which were separately referred to the United State Geological Survey bench marks in their vicinity. Information for a study of flood control was obtained at these stations at times of unusual low and high water; and the points at which the observations were taken are shown in the following table:

TABLE NO. 31.

Location of Points for High and Low Water Conditions.

Number.	Stream.		Miles Below Turnerville.	Location Mark.
1	Shenango, ...	2.55	Jamestown Dam, ...	Mark on abutment
2	Shenango, ...	2.60	Jamestown Highway Bridge, ...	Mark on floor.
3	Shenango, ...	3.40	P. R. R. Bridge No. 23, ...	Mark.
4	Shenango, ...	4.80	Highway Bridge, South Jamestown, ...	Mark.
5	Shenango, ...	7.80	Greenville, Porter Bridge, ...	Mark.
6	Shenango, ...	9.05	Greenville, Mathers Dam, ...	Staff gage.
7	Shenango, ...	9.10	Greenville, Main Street Bridge, ...	Chain gage.
8	Little Shenango,	.....	Greenville, Quaker Bridge, ...	Mark.
9	Shenango, ...	11.57	Shenango, Wasser Bridge, ...	Mark.
10	Shenango, ...	12.87	Hamburg, Kidds Mill Bridge, ...	Mark.
11	Shenango, ...	17.22	Hamburg, Hamburg Dam, ...	Mark.
12	Shenango, ...	17.27	Hamburg, Highway Bridge, ...	Mark.
13	Shenango, ...	17.45	Hamburg, Frantz Mill, ...	Mark.
14	Shenango, ...	21.03	Hamburg, Big Bend Bridge, ...	Mark.
15	Shenango, ...	24.82	Fruits Mill, Highway Bridge, ...	Mark.
16	Shenango, ...	29.00	Clarksville, Highway Bridge, ...	Mark.
17	Shenango, ...	29.90	Clarksville, P. R. R. Bridge, ...	Mark.
18	Shenango, ...	31.55	Sharpsville, Slackwater Bridge, ...	Mark.
19	Shenango, ...	33.80	Sharpsville, Canal Lock and Dam, ...	Top coping.
20	Shenango, ...	33.95	Sharpsville, Upper Furnace Bridge, ...	Mark.
21	Shenango, ...	34.60	Sharpsville, Mercer Street Bridge, ...	Mark.
22	Shenango, ...	37.62	Sharon, Mill Street Bridge, ...	Mark.
23	Shenango, ...	38.10	Sharon, State Street Bridge, ...	Mark.
24	Shenango, ...	38.20	Sharon, Chestnut Street Bridge, ...	Staff gage.
25	Shenango, ...	40.10	Farrell, Carnegie Bridge, ...	Staff gage.
26	Shenango, ...	41.18	Wheatland, Wheatland Bridge, ...	Mark.
27	Shenango, ..	45.25	West Middlesex, Highway Bridge, ...	Mark.
28	Shenango, ...	50.85	Pulaski, Highway Bridge, ...	Mark.
29	Shenango, ...	54.55	Nashua, Highway Bridge, ...	Mark.
30	Shenango, ...	62.60	New Castle, Washington Bridge, ...	Tack.
31	Shenango, ...	65.15	Mahoningtown, High. Bridge above Rainey Dam,	Mark.

The information upon which the foregoing report is based, has been filed in the office of the Commission.

For the purpose of keeping a record of the high and low water conditions along the river and throughout the swamp, 18 points were selected on the several bridges over the streams, the elevations of which were referred to the system of levels previously described. The following is a list showing the points at which records have been taken from February, 1912, to date.

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7	Linesville creek,	Linesville, Bullistown Bridge, ...	16.50	Mark.
8	Linesville creek,	Linesville, P. R. R. Bridge No. 17, ...	15.62	Wier and mark.
9	Shenango, ...	North Shenango, P. R. R. Bridge No. 18, ...	15.18	Mark.
10	Padan creek, ...	Pine, Finley's Bridge, ...	16.10	Mark.
11	Padan creek, ...	Pine, Swamp Road Bridge, ...	13.02	Mark.
12	Shenango, ...	North Shenango, Pollocks Bridge, ...	11.40	Staff gage.
13	Shenango, ...	North Shenango, Manning Bridge, ...	9.69	Mark.
14	Shenango, ...	North Shenango, Andover Highway Bridge, ...	8.30	Mark.
15	Shenango, ...	North Shenango, Westford Highway Bridge, ..	4.15	Staff gage.
16	Shenango, ...	North Shenango, 2d Bridge above Turners, ...	2.61	Mark.
17	Shenango, ...	North Shenango, 1st bridge above Turners, ...	1.93	Mark.
18	Shenango, ...	North Shenango, Turnersville Bridge, ...	0.00	Staff and chain gage.

Below the dam site thirty-one points were selected throughout a distance of 65 miles, from the Turnerville Bridge to the Rainey Dam at Mahoningtown, all of which were separately referred to the United State Geological Survey bench marks in their vicinity. Information for a study of flood control was obtained at these stations at times of unusual low and high water; and the points at which the observations were taken are shown in the following table:

TABLE NO. 31.

Location of Points for High and Low Water Conditions.

Number.	Stream.		Miles Below Turnerville.	Location Mark.
1	Shenango,	2.55	Jamestown Dam,	Mark on abutment
2	Shenango,	2.60	Jamestown Highway Bridge,	Mark on floor.
3	Shenango,	3.40	P. R. R. Bridge No. 23,	Mark.
4	Shenango,	4.80	Highway Bridge, South Jamestown,	Mark.
5	Shenango,	7.80	Greenville, Porter Bridge,	Mark.
6	Shenango,	9.05	Greenville, Mathers Dam,	Staff gage.
7	Shenango,	9.10	Greenville, Main Street Bridge,	Chain gage.
8	Little Shenango,	.....	Greenville, Quaker Bridge,	Mark.
9	Shenango,	11.57	Shenango, Wasser Bridge,	Mark.
10	Shenango,	12.87	Hamburg, Kidds Mill Bridge,	Mark.
11	Shenango,	17.22	Hamburg, Hamburg Dam,	Mark.
12	Shenango,	17.27	Hamburg, Highway Bridge,	Mark.
13	Shenango,	17.45	Hamburg, Frantz Mill,	Mark.
14	Shenango,	21.03	Hamburg, Big Bend Bridge,	Mark.
15	Shenango,	24.82	Fruits Mill, Highway Bridge,	Mark.
16	Shenango,	29.00	Clarksville, Highway Bridge,	Mark.
17	Shenango,	29.90	Clarksville, P. R. R. Bridge,	Mark.
18	Shenango,	31.55	Sharpsville, Slackwater Bridge,	Mark.
19	Shenango,	33.80	Sharpsville, Canal Lock and Dam,	Top coping.
20	Shenango,	33.95	Sharpsville, Upper Furnace Bridge,	Mark.
21	Shenango,	34.60	Sharpsville, Mercer Street Bridge,	Mark.
22	Shenango,	37.62	Sharon, Mill Street Bridge,	Mark.
23	Shenango,	38.10	Sharon, State Street Bridge,	Mark.
24	Shenango,	38.20	Sharon, Chestnut Street Bridge,	Staff gage.
25	Shenango,	40.10	Farrell, Carnegie Bridge,	Staff gage.
26	Shenango,	41.18	Wheatland, Wheatland Bridge,	Mark.
27	Shenango,	45.25	West Middlesex, Highway Bridge,	Mark.
28	Shenango,	50.85	Pulaski, Highway Bridge,	Mark.
29	Shenango,	54.55	Nashua, Highway Bridge,	Mark.
30	Shenango,	62.60	New Castle, Washington Bridge,	Tack.
31	Shenango,	65.15	Mahoningtown, High. Bridge above Rainey Dam,	Mark.

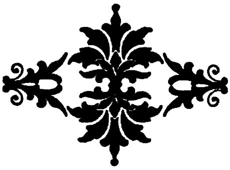
The information upon which the foregoing report is based, has been filed in the office of the Commission.

APPENDIX B

HYDROGRAPHIC DATA

FOR

1912



DELAWARE BASIN

GAGING STATIONS IN DELAWARE BASIN.

No.	Stream.	Location.	Established.	Discontinued	Re-Established.	1912 Information Available.
1	West Br. Delaware river, ...	Hancock, N. Y., ...	October 15, 1902,....			Discharge complete.
2	East Br. Delaware river, ...	Hancock, N. Y., ...	October 14, 1902,....			Discharge complete.
3	Lackawaxen river, ...	Hawley, Pa., ...	July 2, 1908, ...			Discharge complete.
4	Wallenpaupack creek, ...	Wilsonville, Pa., ...	July 3, 1908,......			Discharge measurements and gage heights.
5	Shohola creek, ...	Lord's Valley, Pa., ...	September 22, 1911,			Discharge measurements and gage heights.
6	Rattlesnake brook, ...	Spring Brook, Pa., ...	September 22, 1911,			Discharge measurements and gage heights.
7	Delaware river, ...	Port Jervis, N. Y., ...	October 12, 1904,....			Discharge complete.
8	Big Bushkill creek, ...	Shoemakers, Pa., ...	September 19, 1908,			Discharge complete.
9	Brodheads creek, ...	Analomink, Pa., ...	September 17, 1908,			Discharge measurements and gage heights.
10	Pocono creek, ...	Stroudsburg, Pa., ...	August 3, 1911, ...			Discharge measurements and gage heights.
11	McMichaels creek, ...	Stroudsburg, Pa., ...	August 3, 1911, ...			Discharge measurements and gage heights.
12	Lehigh river, ...	South Bethlehem, Pa., ...	September 22, 1902,	February 13, 1905,..	April 26, 1909, ...	Discharge complete.
13	Delaware river, ...	Riegelsville, N. J., ...	July 3, 1906, ...			Discharge complete.
14	Tohickon creek, ...	Point Pleasant, Pa., ...	September 13, 1883,			Discharge complete.
15	Neshaminy creek, ...	Rushland, Pa., ...	June 10, 1884, ...			Discharge complete.
16	Perkiomen creek, ...	Frederick, Pa., ...	August 20, 1884, ...			Discharge complete.
17	Schuylkill river, ...	Philadelphia, Pa., ...	January 1, 1906, ...			Discharge complete.
18	Darby creek, ...	Lansdowne, Pa., ...	July 31, 1911, ...			Discharge measurements and gage heights.
19	Brandywine creek, ...	Chadd's Ford, Pa., ...	August 1, 1911,......			Discharge measurements and gage heights.

WEST BRANCH DELAWARE RIVER.

DESCRIPTION OF BASIN.

This stream has its source in a small lake almost on the line of Schoharie and Delaware counties, New York, at an elevation of approximately 1,900 feet above sea level, on the western slope of the Catskill mountains and drains a total of 660 square miles. It flows southwesterly through a hilly, plateau region, well populated in the main valley, and the hills well timbered, to Deposit, about 5 miles above the State Line, where it turns southeast and in about 5 miles joins the East Branch at Hancock, New York. About 8 miles above Deposit at Cannonsville is the site of a large storage reservoir proposed by the State Water Supply Commission of New York to flood a long, broad valley, and contain approximately 7,000,000,000 cubic feet available storage.

At Hancock, the elevation is 895 feet above sea level, and the rise from there to Cannonsville, 16 miles above, is at the rate of 7 feet per mile, while above this point the slope is steeper. In the upper section there are numerous lakes, ponds and swampy areas, the basin being relatively long and narrow with numerous short, lateral tributaries. The largest tributary is Oquaga creek, which comes in at Deposit from the west. The mean annual precipitation over this watershed is approximately 40 inches.

The discharge of this stream has been measured since October, 1902, at Hancock, N. Y., near its mouth.

DELAWARE BASIN—STATION NO. 1.

WEST BRANCH DELAWARE RIVER AT HANCOCK, N. Y.

DESCRIPTION OF STATION.

This station was established October 15, 1902, by the United States Geological Survey for the United States Weather Bureau. It is located at the toll, suspension bridge half a mile west of the Erie Railroad station at Hancock, N. Y., and about one mile above the junction of the east and west branches.

The channel is straight for 400 feet above and 800 feet below the bridge. The current is swift. Both banks are high and rocky, and are not subject to overflow. The bed of the stream is composed of sand, gravel and cobble-stones.

Discharge measurements are made from the downstream side of the bridge, on which the gage is located. The bridge has a single span of 235 feet. The initial point for soundings is the top of the face of the left abutment on the downstream side.

The original wire gage was attached to the upstream side of the bridge. It was replaced July 20, 1903, by a standard chain gage. The location and the gage datum were not changed. The length of the chain from the end of the weight to the marker is 29.39 feet. The gage is read once each day by David Pulver, the collector of tolls at the bridge. The bench mark is a circular chisel draft on the upstream corner of the left abutment. Its elevation is 24.25 feet above gage datum. The elevation of the top of the pulley is 30.54 feet above gage datum.

The high water stage is probably affected by backwater from the East Branch of the Delaware river. The low water stage is controlled by riffles about 800 feet below the station, but frequent changes in conditions of flow require many measurements and new ratings each year. During the winter months the discharge is affected considerably by ice.

This station has been operated by the United States Weather Bureau, in conjunction with the United States Geological Survey and the New York State Engineer and Surveyor.

Since the establishment of this station, 41 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WEST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

(Drainage area 660 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
38	Feb. 23	De Golyer, ...	209	1100	1.52	5.99	1670	Measurement under partial ice cover.
39	July 27	Weber, ...	72	54	1.26	2.58	68	Wading ½ mile above gage.
40	July 27	Weber, ...	56	78	0.88	2.58	69	Wading ½ mile above gage.
41	Nov. 21	Weber, ...	217	465	1.44	3.71	658	0.2 and 0.8 method.

DISCHARGE TABLE FOR WEST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y. FOR 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
2.40	28	.70	652	5.00	2070	.30	4630	.60	8360
.50	50	.80	736	.10	2230	.40	4880	.70	8690
.60	76	.90	826	.20	2400	.50	5130	.80	9030
.70	106	4.00	918	.30	2570	.60	5390	.90	9360
.80	142	.10	1010	.40	2750	.70	5660	8.00	9700
.90	182	.20	1110	.50	2930	.80	5930	8.50	11430
3.00	225	.30	1210	.60	3120	.90	6210	9.00	13300
.10	272	.40	1310	.70	3310	7.00	6500	10.00	17100
.20	324	.50	1420	.80	3510	.10	6790	11.00	21110
.30	380	.60	1530	.90	3720	.20	7090		
.40	440	.70	1650	6.00	3940	.30	7400		
.50	506	.80	1780	.10	4160	.40	7720		
.60	576	.90	1920	.20	4390	.50	8040		

Note. This table is only applicable subsequent to January 1, 1912 and is based on 7 discharge measurements made during 1910-11-12, and coincides with the 1910-11 curve above gage height 6.7 feet.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WEST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	D's.	G H	D's.
1,	4.0	918	4.0	......	5.5	......	7.2	7090	4.5	1420	3.5	506	2.4	28	2.5	50	3.0	225	3.5	506	3.5	506	3.3	380
2,	3.4	440	4.0	......	5.6	......	7.2	7090	4.6	1530	3.3	380	2.6	76	2.5	50	4.3	1210	3.5	506	4.1	1010	3.5	506
3,	3.6	576	3.9	......	5.6	......	8.2	10400	4.4	1310	3.5	506	2.4	28	2.5	50	3.9	826	3.3	380	3.9	826	6.2	4390
4,	3.5	506	3.9	......	5.4	......	6.6	5390	4.2	1110	3.5	506	2.5	50	2.5	50	3.7	652	3.3	380	3.6	576	5.7	3310
5,	3.5	506	3.9	......	5.1	......	6.1	4160	4.1	1010	3.5	506	2.5	50	2.5	50	3.5	506	3.2	324	3.5	506	5.3	2570
6,	2.9	182	3.7	......	5.4	......	6.0	3940	4.0	918	3.5	506	2.5	50	2.5	50	3.4	440	3.1	272	3.5	506	5.5	2930
7,	3.4	......	3.7	......	5.2	......	6.1	4160	4.1	1010	3.6	576	2.5	50	2.5	50	3.3	380	3.1	272	3.5	506	5.6	3120
8,	4.0	......	3.8	......	5.1	......	7.2	7090	4.1	1010	3.5	506	2.5	50	2.5	50	3.2	324	3.0	225	6.9	6210	5.1	2230
9,	4.6	......	3.6	......	6.0	......	6.1	4160	4.2	1110	3.4	440	2.5	50	2.5	50	3.2	324	2.9	182	5.9	3720	4.7	1650
10,	4.7	......	3.6	......	6.0	......	5.7	3310	4.1	1010	3.2	324	2.5	50	2.5	50	3.0	225	3.0	225	5.3	2570	4.2	1110
11,	4.7	......	3.5	......	5.6	......	5.5	2930	3.9	826	3.1	272	2.5	50	3.4	440	2.9	182	3.0	225	4.9	1920	4.3	1210
12,	4.7	......	3.5	......	5.2	......	5.3	2570	3.8	736	3.2	324	2.6	76	3.1	272	3.0	225	3.1	272	4.6	1530	4.0	918
13,	4.6	......	3.6	......	7.2	......	5.5	2930	3.8	736	3.0	225	2.5	50	2.9	182	3.0	225	3.0	225	4.4	1310	3.6	576
14,	4.4	......	3.7	......	10.8	......	5.2	2400	3.7	652	3.0	225	2.6	76	2.9	182	2.9	182	3.0	225	4.4	1310	3.5	506
15,	4.7	......	3.5	......	5.5	.....	5.0	2070	3.7	652	3.0	225	2.6	76	2.8	142	2.9	182	2.9	182	4.2	1110	3.9	826
16,	4.5	......	3.5	......	10.0	17100	7.6	8360	3.6	576	3.0	225	2.6	76	2.8	142	2.9	182	2.9	182	4.0	918	3.8	736
17,	4.5	......	3.6	......	6.8	5930	7.0	6500	4.2	1110	3.1	272	2.5	50	2.7	106	2.9	182	2.9	182	4.0	918	3.7	652
18,	4.5	......	3.6	......	6.8	5930	7.1	6790	4.6	1530	3.0	225	2.6	76	2.7	106	3.0	225	2.8	142	3.8	736	3.7	652
19,	4.6	......	3.8	......	6.7	5660	7.4	7720	4.3	1210	3.0	225	2.8	142	3.0	225	3.2	324	2.9	182	3.7	652	4.0	918
20,	4.7	......	3.8	......	6.9	6210	6.8	5930	4.1	1010	2.8	142	2.6	76	3.1	272	3.2	324	2.9	182	3.7	652	5.0	2070
21,	5.2	......	4.1	......	6.0	3940	6.0	3940	4.1	1010	2.8	142	2.5	50	3.0	225	3.1	272	2.9	182	3.6	576	4.4	1310
22,	4.9	......	4.8	......	5.3	2570	6.0	3940	4.1	1010	2.7	106	2.5	50	3.3	380	3.0	225	2.9	182	3.5	506	4.2	1110
23,	4.7	......	6.0	......	5.0	2070	5.5	2930	3.9	826	2.7	106	2.5	50	3.3	380	3.0	225	3.0	225	3.5	506	4.0	918
24,	4.6	......	5.5	......	4.9	1920	5.4	2750	3.8	736	2.9	182	2.5	50	3.6	576	3.1	272	5.5	2930	3.4	440	3.8	736
25,	4.5	......	5.4	......	4.5	1420	5.2	2400	3.7	652	2.7	106	2.5	50	3.3	380	4.0	918	6.3	4630	3.5	506	4.0	918
26,	4.4	......	6.0	......	4.1	1010	5.1	2230	3.6	576	2.6	76	2.4	28	3.6	576	3.9	826	5.3	2570	3.7	652	3.8	736
27,	4.3	......	6.0	......	4.2	1110	4.8	1780	3.5	506	2.6	76	2.5	50	3.2	324	3.8	736	5.2	2400	3.7	652	3.9	826
28,	4.3	......	6.5	......	4.3	1210	4.7	1650	3.4	440	2.5	50	2.5	50	3.0	225	3.5	506	4.4	1310	3.6	576	3.6	576
29,	4.2	......	6.0	......	6.8	5930	4.4	1310	3.4	440	2.6	76	2.6	76	3.0	225	3.3	380	4.2	1110	3.5	506	3.5	506
30,	4.2	......	....	......	8.2	10400	4.0	918	3.5	506	2.5	50	2.6	76	3.0	225	3.5	506	4.0	918	3.4	440	3.9	826
31,	4.2	......	....	......	6.5	5130	....	......	3.6	576	....	......	2.6	76	2.9	182	....	......	3.8	736	....	......	4.8	1780

Note.—January 7-March 15, inclusive, river frozen. See "Estimated Monthly Discharge" for estimate during this period.

ESTIMATED MONTHLY DISCHARGE OF WEST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

(Drainage area 660 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912					
January,	....	....	523	0.792	0.91
February,	....	....	528	0.800	0.86
March,	17100	....	3600	5.450	6.28
April,	10400	918	4290	6.500	7.25
May,	1530	440	895	1.360	1.57
June,	576	50	270	0.409	0.46
July,	142	28	59	0.090	0.10
August,	576	50	202	0.306	0.35
September,	1210	182	407	0.617	0.69
October,	4630	182	725	1.100	1.27
November,	6210	440	1110	1.680	1.87
December,	4390	380	1340	2.030	2.34
The year,	....	....	1160	1.760	23.95

Note. River frozen January 7-March 15, inclusive. Discharge estimated from one discharge measurement under partial ice cover, and climatological records.

EAST BRANCH DELAWARE RIVER.

DESCRIPTION OF BASIN.

This stream rises at Grand Gorge in northeast Delaware County, New York, on the western slope of the Catskill mountains, at an elevation of 1,560 feet above sea level, and flows southwest through a hilly, plateau region, well populated in the main valley and in those of some of the largest tributaries, to its junction with the West Branch at Hancock, New York. The headwaters of its tributaries are in a wild, uninhabited region, well timbered, the highest hills reaching to 4,000 feet above sea level. Its largest tributary is Beaver Kill, coming in about 20 miles above Hancock on which stream are many lakes and ponds. The drainage area is broader and tributaries longer than those of the West Branch.

The total drainage area of the East Branch is 840 square miles, over which the mean annual precipitation is approximately 40 inches.

From its mouth to Margaretville, a distance of about 55 miles, the slope is 430 feet, giving an average slope of 8 feet per mile.

The discharge has been measured at Hancock, New York, since October, 1902.

DELAWARE BASIN—STATION NO. 2.

EAST BRANCH DELAWARE RIVER AT HANCOCK, NEW YORK.

DESCRIPTION OF STATION.

This station was established October 14, 1902, by the United States Geological Survey for the United States Weather Bureau.

It is located at the highway bridge one-half mile southeast of the Erie Railroad station at Hancock, N. Y., and one mile above the junction with West Branch of the Delaware. The Erie Railroad bridge is just below the station.

The channel is straight for 600 feet above and 300 feet below the station. The current is swift. Both banks are of medium height and are not liable to overflow. The bed of the stream is composed of rocks and gravel. There are three channels at low water and four channels at high water. During low water the elevation of the water surface at the station is lower than the water surface on West Branch of the Delaware, but there is no danger of the gage heights being affected by backwater from the West Branch, as there is considerable fall between the gaging station and the junction of the branches.

Discharge measurements are made from the downstream side of the five span, iron, highway bridge to which the gage is attached. The bridge has a total span of 425.5 feet between abutments. The initial point for soundings is the face of the right abutment at the top.

A standard chain gage is attached to the lower chord of the second span from the left end of the bridge on the upstream side. It was installed July 21, 1903, to replace the old wire gage. The gage datum was not changed. The length of the chain from the end of the weight to marker is 32.49 feet. The gage is read once daily by D. B. Van-Etten. The bench mark is a circular chisel draft on the top of the left abutment on the downstream side, and is marked "B. M." Its elevation is 27.93 feet above gage datum. The elevation of the top of the gage pulley is 32.40 feet above gage datum.

Conditions for accurate ratings can not be considered good. The high water stage of the East Branch is probably affected by backwater due to gorging at its junction with the West Branch. Low water discharge is controlled by a rift just below the Erie Railroad bridge, but frequent changes in conditions of flow may require many measurements and new ratings each year. During the winter months the discharge is affected by needle ice jamming on these rifts causing backwater at the station.

This station has been operated by the United States Weather Bureau, in conjunction wtih the United States Geological Survey and the New York State Engineer and Surveyor.

Since the establishment of this station, 40 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF EAST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

(Drainage area 840 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
37	Feb. 22	De Golyer, ...	314	763	1.66	5.14	1270	Ice measurement.
38	July 27	Weber, ...	312	328	0.70	2.78	228	Wading measurement.
39	Nov. 20	Weber, ...	283	683	1.68	3.69	1060	0.2 and 0.8 method.
40	Nov. 22	Weber.	278	587	1.55	3.58	910	0.2 and 0.8 method.

DISCHARGE TABLE FOR EAST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y. FOR 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.		
2.40	70	.20	1880	6.00	6070	.80	11800	.60	18300
.50	104	.30	2060	.10	6350	.90	12200	.70	18700
.60	144	.40	2250	.20	6640	8.00	12500	.80	19000
.70	190	.50	2440	.30	6930	.10	12800	.90	19400
.80	240	.60	2640	.40	7230	.20	13200	10.00	19800
.90	300	.70	2850	.50	7540	.30	13600	.10	20200
3.00	370	.80	3070	.60	7850	.40	13900	.20	20600
.10	440	.90	3290	.70	8170	.50	14200	.30	20900
.20	520	5.00	3520	.80	8490	.60	14600	.40	21300
.30	610	.10	3750	.90	8810	.70	15000	.50	21700
.40	710	.20	3990	7.00	9140	.80	15300	.60	22100
.50	820	.30	4230	.10	9470	.90	15700	.70	22500
.60	940	.40	4480	.20	9800	9.00	16000	.80	22900
.70	1070	.50	4730	.30	10100	.10	16400	.90	23300
.80	1220	.60	4990	.40	10500	.20	16800	11.00	23700
.90	1380	.70	5250	.50	10800	.30	17200		
4.00	1540	.80	5520	.60	11100	.40	17500		
.10	1710	.90	5790	.70	11500	.50	17900		

Note. This table is only applicable subsequent to January 1, 1912. and is based on 7 discharge measurements made during 1910-11-12, and is parallel to the curve used for 1910-11.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF EAST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

1912.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	4.2	1880	4.5	......	5.0	......	6.9	8810	5.1	3750	3.6	940	2.7	190	2.8	240	3.2	520	3.2	520	3.8	1220	3.5	820
2, ...	3.9	1380	4.5	......	4.8	......	6.9	8810	4.8	3070	3.5	820	2.7	190	2.7	190	3.5	820	3.3	610	4.2	1880	3.5	820
3, ...	4.0	1540	4.4	......	4.7	......	10.0	19800	4.6	2640	3.5	820	2.6	144	2.7	190	3.8	1220	3.2	520	4.0	1540	6.7	8170
4, ...	4.5	2440	4.4	......	4.6	......	7.1	9470	4.4	2250	3.6	940	2.6	144	2.7	190	3.8	1220	3.2	520	3.8	1220	5.6	4990
5, ...	4.2	1880	4.3	......	4.6	......	6.0	6070	4.3	2060	3.5	820	2.6	144	2.7	190	3.6	940	3.1	440	3.7	1070	5.2	3990
6, ...	3.7	1070	4.3	......	4.5	......	5.9	5790	4.2	1880	3.4	710	2.6	144	2.7	190	3.5	820	3.1	440	3.7	1070	5.0	3520
7, ...	3.8	1220	4.3	......	4.4	......	6.3	6930	4.3	2060	3.6	940	2.6	144	2.6	144	3.5	820	3.1	440	3.7	1070	5.6	4990
8, ...	3.9	1380	4.3	......	4.4	......	7.6	11100	4.2	1880	3.6	940	2.6	144	2.5	104	3.4	710	3.0	370	5.9	5790	5.2	3990
9, ...	4.9	......	4.2	......	4.6	......	6.3	6930	4.4	2250	3.4	710	2.6	144	2.5	104	3.3	610	3.0	370	5.3	4230	4.9	3290
10, ...	4.8	......	4.2	......	4.8	.....	5.7	5250	4.4	2250	3.3	610	3.0	370	2.7	190	3.3	610	3.0	370	4.9	3290	4.6	2640
11, ...	4.8	......	4.1	......	4.6	......	5.4	4480	4.2	1880	3.3	610	2.9	300	4.4	2250	3.2	520	3.1	440	4.6	2640	4.4	2250
12, ...	4.8	......	4.1	......	4.4	......	5.1	3750	4.0	1540	3.2	520	2.9	300	3.8	1220	3.2	520	3.1	440	4.5	2440	4.3	2060
13, ...	4.6	......	4.1	......	4.8	......	5.2	3990	4.2	1880	3.2	520	2.8	240	3.4	710	3.2	520	3.1	440	4.3	2060	4.0	1540
14, ...	4.6	......	4.1	......	5.6	......	5.0	3520	4.1	1710	3.2	520	2.9	300	3.3	610	3.1	440	3.0	370	4.2	1880	4.0	1540
15, ...	4.6	......	4.1	......	5.1	......	4.9	3290	4.0	1540	3.1	440	3.0	370	3.1	440	3.0	370	3.0	370	4.2	1880	4.0	1540
16, ...	4.6	......	4.1	......	10.9	23800	7.4	10500	4.0	1540	3.1	440	2.9	300	3.1	440	3.2	520	3.0	370	4.0	1540	3.9	1380
17, ...	4.5	......	4.1	......	6.9	8810	7.3	10100	5.0	3520	3.1	440	2.8	240	3.0	370	3.2	520	2.9	300	3.9	1380	3.8	1220
18, ...	4.5	......	4.2	......	6.6	7850	6.8	8490	4.9	3290	3.1	440	3.4	710	3.1	440	3.1	440	2.9	300	3.8	1220	3.7	1070
19, ...	4.7	......	4.2	......	6.7	8170	7.5	10800	4.6	2640	3.0	370	3.5	820	3.3	610	3.1	440	2.9	300	3.7	1070	4.0	1540
20, ...	4.9	......	4.2	......	6.7	8170	6.7	8170	4.5	2440	3.0	370	3.2	520	3.4	710	3.2	520	3.0	370	3.7	1070	5.0	3520
21, ...	5.0	......	4.3	......	6.6	7850	5.9	5790	4.4	2250	2.9	300	3.0	370	3.3	610	3.1	440	3.0	370	3.6	940	4.5	2440
22, ...	4.9	......	4.9	......	5.5	4730	5.4	4480	4.2	1880	2.9	300	3.1	440	3.8	1220	3.0	370	3.0	370	3.6	940	4.3	2060
23, ...	4.9	......	5.6	......	4.9	3290	5.3	4230	4.2	1880	2.9	300	3.0	370	3.9	1380	3.0	370	3.0	370	3.5	820	4.2	1880
24, ...	4.8	......	5.3	......	4.9	3290	5.1	3750	4.0	1540	2.9	300	2.9	300	4.3	2060	3.1	440	6.1	6350	3.5	820	4.2	1880
25, ...	4.7	......	5.2	......	4.7	2850	5.2	3990	4.0	1540	2.9	300	2.8	240	3.9	1380	3.4	710	5.9	5790	3.9	1380	4.2	1880
26, ...	4.7	......	5.3	......	4.3	2060	4.8	3070	3.8	1220	2.8	240	2.8	240	4.0	1540	3.5	820	5.1	3750	3.9	1380	4.0	1540
27, ...	4.7	......	5.4	......	4.3	2060	4.7	2850	3.7	1070	2.8	240	2.8	240	3.8	1220	3.4	710	4.7	2850	3.7	1070	4.0	1540
28, ...	4.7	......	5.8	......	5.5	4730	4.7	2850	3.6	940	2.8	240	2.7	190	3.6	940	3.3	610	4.4	2250	3.7	1070	3.9	1380
29, ...	4.6	......	5.4	......	7.8	11800	4.5	2440	3.5	820	2.7	190	2.7	190	3.5	820	3.2	520	4.3	2060	3.6	940	4.0	1540
30, ...	4.6	......	....	......	7.8	11800	5.6	4990	3.9	1380	2.7	190	2.8	240	3.5	820	3.2	520	4.1	1710	3.6	940	4.0	1540
31, ...	4.6	......	....	......	6.3	6930	....	......	3.8	1220	....	......	2.8	240	3.3	610	....	......	3.9	1380	....	......	5.4	4480

Note. January 9-March 15, inclusive, river frozen. See "Estimated Monthly discharge" for estimate during this period.

ESTIMATED MONTHLY DISCHARGE OF EAST BRANCH DELAWARE RIVER, AT HANCOCK, N. Y.

(Drainage area 840 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	1240	1.480	1.71
February,	....	....	1010	1.200	1.29
March,	23800	....	4660	5.550	6.40
April,	19800	2440	6480	7.710	8.60
May,	3750	820	1990	2.370	2.73
June,	940	190	517	0.615	0.69
July,	820	144	288	0.343	0.40
August,	2250	104	714	0.850	0.98
September,	1220	370	620	0.738	0.82
October,	6350	300	1150	1.370	1.58
November,	5790	820	1660	1.980	2.21
December,	8170	820	2490	2.960	3.41
The year,	....	....	1900	2.260	30.82

Note. River frozen January 9-March 15, inclusive. Discharge estimated from one discharge measurement under ice cover, and climatological records.

LACKAWAXEN RIVER.

DESCRIPTION OF BASIN.

Lackawaxen river, the third largest tributary of the Delaware river in Pennsylvania, drains approximately 600 square miles in Pike and Wayne counties. Rising in a lake in the northwestern part of Wayne county, it follows a southeasterly course through a well populated agricultural region to Hawley, approximately 13 miles above its mouth, at which point it is joined by its largest tributary, Wallenpaupack creek; thence following an easterly direction through a narrow, precipitous valley, covered with second growth timber, and sparsely inhabited, to its mouth at Lackawaxen, Pike county, the total length being approximately 50 miles. Its source is at an elevation of about 1,950 feet above sea level, and its mouth about 600 feet. The principal tributaries are Dyberry, Middle and Wallenpaupack creeks, the watershed including a great number of lakes and ponds, and above Hawley it is wide and spreads out along its several large tributaries, converging at this point. The stream lies entirely within the glacial area, the slope being steep and the flow rapid for most of its course. The valley in its upper section is wide, gradually narrowing as the stream leaves the plateau, and flowing through a gorge in the mountains to the Delaware river. In its drainage basin lie the principal boroughs and villages of the county, several of which obtain water supplies from the tributaries and lakes in its watershed. The stream is used to a small extent for power purposes, while some sites are as yet undeveloped. The average yearly rainfall over this watershed is from 40 to 45 inches. The flow of this stream has been measured since July 2, 1908, at Hawley, approximately 13 miles above the mouth.

DELAWARE BASIN—STATION NO. 3.

LACKAWAXEN RIVER AT HAWLEY.

DESCRIPTION OF STATION.

This station was established July 2, 1908, by the Water Supply Commission of Pennsylvania, on a single span, through truss, highway bridge, about 2,000 feet above the mouth of Wallenpaupack creek. A standard chain gage is fastened to the upstream handrail of the bridge. The length of chain from center of rivet to bottom of weight is 23.42 feet, the elevation of zero being arbitrary datum. A bench mark is located on a spike 2 feet in from face of right abutment, upstream side, and 3 feet up from ground, rod held close to abutment, elevation being 7.03 feet above zero of gage.

Discharge measurements are made from the upstream side of the bridge, and by wading at low stages. The initial point for soundings is the outer edge of upstream iron handrail post, right bank. The channel is straight for about 150 feet above and below the station. The left bank is high and not subject to overflow, while the right bank overflows during extreme high stages. The bed is permanent, being composed of rock and gravel. Intermittent storage upstream at Honesdale affects the flow during low stages. The gage is read twice daily by J. S. Pennell.

Since the establishment of the gage, eleven discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF LACKAWAXEN RIVER, AT HAWLEY, WAYNE COUNTY, PA.

(Drainage area 290 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1913		Feet.	Sq. ft.	per Ft. sec.	Feet.	Sec. ft.	
11	March 19	Reckord & Knight,...	118	372	1.95	3.08	716	0.6 measurement.

DISCHARGE TABLE FOR LACKAWAXEN RIVER, AT HAWLEY, WAYNE COUNTY, FROM JAN. 1st, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.00	26	.50	222	3.00	678	.50	1410	6.00	2288
.10	32	.60	244	.10	720	.60	1464	.10	2352
.20	38	.70	266	.20	764	.70	1520	.20	2416
.30	46	.80	290	.30	808	.80	1576	.30	2482
.40	54	.90	314	.40	854	.90	1632	.40	2548
.50	64	2.00	340	.50	902	5.00	1690	.50	2616
.60	74	.10	368	.60	950	.10	1748	.60	2684
.70	86	.20	396	.70	998	.20	1806	.70	2754
.80	100	.30	426	.80	1048	.30	1864	.80	2824
.90	114	.40	458	.90	1098	.40	1922	.90	2894
1.00	128	.50	490	4.00	1148	.50	1982	7.00	2966
.10	144	.60	524	.10	1198	.60	2042		
.20	162	.70	560	.20	1250	.70	2102		
.30	182	.80	598	.30	1302	.80	2164		
.40	202	.90	638	.40	1356	.90	2226		

Note:—This table is only applicable subsequent to January 1, 1912, and is based on two discharge measurements made during 1912 together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF LACKAWAXEN RIVER, AT HAWLEY, WAYNE COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPT.		OCT.		NOV.		DEC.	
	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G.H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	2.00	340	....	290	......	400	5.58	2030	4.36	1380	1.38	198	0.51	65	0.07	30	‡1.47	216	2.05	354	2.15	382	‡1.55	233
2, ...	2.70	560	....	290	......	400	4.78	1560	3.88	1090	‡1.62	248	0.49	63	0.17	36	1.79	288	1.73	273	2.00	340	1.46	214
3, ...	2.40	458	....	290	......	400	b6.98	2950	3.48	892	1.86	304	0.32	48	0.05	29	1.83	297	1.45	212	‡1.98	322	4.45	1880
4, ...	2.30	426	....	290	......	400	4.88	1620	3.13	733	1.58	240	0.25	43	‡0.17	36	1.55	233	1.60	244	1.85	302	3.98	1110
5, ...	2.28	420	....	290	......	400	4.28	1290	‡3.06	708	1.63	251	0.39	53	0.28	44	1.67	259	1.30	182	1.60	244	4.13	1210
6, ...	*2.20	396	....	290	......	400	3.98	1140	2.98	670	1.43	208	0.29	45	0.27	44	0.92	117	‡1.23	168	1.55	233	4.65	1490
7, ...	......	240	....	290	......	400	‡4.28	1290	2.96	662	1.60	244	‡0.28	44	0.12	33	1.09	142	1.15	153	1.45	212	3.95	1120
8, ...	......	240	....	290	......	400	4.58	1450	3.08	712	1.50	222	0.27	44	0.12	33	‡0.68	84	0.90	114	3.20	764	‡3.45	878
9, ...	......	240	....	290	......	400	3.83	1060	3.88	1090	‡1.29	180	0.27	44	0.17	36	0.27	44	0.85	107	2.65	542	2.95	658
10, ...	......	240	....	290	......	400	3.53	916	3.63	964	1.08	141	0.29	45	0.53	67	0.57	71	0.85	107	‡2.30	426	2.70	560
11, ...	......	240	....	290	......	400	3.43	868	3.28	799	0.98	125	0.31	47	‡0.67	82	0.51	65	1.00	128	1.95	327	2.40	458
12, ...	......	240	....	290	......	400	3.28	799	‡3.04	695	0.93	118	0.36	51	0.67	82	0.47	61	0.85	107	1.90	314	2.35	44[illegible]
13, ...	......	240	....	290	†6.20	2420	3.16	746	2.80	598	0.80	100	0.35	50	0.87	110	0.37	52	‡0.90	114	1.75	278	1.97	332
14, ...	......	240	....	290	4.30	1800	‡3.14	738	2.66	546	0.73	90	‡0.57	71	0.52	66	0.37	52	0.95	121	1.93	322	1.95	327
15, ...	......	240	....	290	4.00	1150	3.13	733	2.53	500	0.77	96	0.57	71	0.37	52	‡0.36	51	0.85	107	1.73	273	‡1.90	314
16, ...	......	240	....	290	7.25	f3150	3.48	892	‡3.98	1140	‡0.78	97	0.49	63	0.62	76	0.35	50	0.65	80	1.66	257	1.85	302
17, ...	......	240	....	290	6.60	2680	5.43	1940	4.33	1340	0.78	97	0.42	56	0.46	60	0.42	56	0.70	86	‡1.59	242	1.83	297
18, ...	......	240	....	290	5.30	1560	5.38	1910	‡3.53	916	0.83	104	0.49	63	‡0.87	110	0.57	71	0.71	87	1.58	229	1.85	302
19, ...	......	240	....	290	4.60	1460	5.00	1690	2.68	553	0.68	84	0.45	59	c1.15	153	0.72	89	0.73	90	1.54	231	2.45	474
20, ...	......	240	....	290	4.95	1660	4.40	1360	2.58	517	0.67	82	0.35	50	1.17	157	0.87	110	‡0.65	80	1.47	216	2.95	658
21, ...	......	240	....	290	4.20	1250	‡3.94	1120	2.46	477	0.68	84	‡0.47	61	0.85	107	0.77	96	0.57	71	1.45	212	2.80	598
22, ...	......	240	....	290	3.95	1120	3.48	892	2.28	420	0.77	96	0.58	72	0.67	82	‡0.72	89	0.55	69	1.41	204	‡2.85	442
23, ...	......	240	....	290	3.45	878	3.63	964	2.18	376	‡0.73	90	0.51	65	0.47	61	0.67	82	1.10	144	1.38	194	1.90	314
24, ...	......	240	....	290	‡3.38	845	3.20	764	1.88	309	0.69	85	0.45	59	0.45	59	1.27	176	3.10	720	‡1.61	246	1.95	327
25, ...	......	240	....	290	3.30	808	3.06	708	1.88	309	0.66	81	0.22	40	0.35	50	4.07	1180	4.95	1660	1.87	307	2.13	376
26, ...	......	240	....	290	3.20	764	2.88	630	‡1.72	271	0.57	71	0.17	36	0.49	63	d4.35	1330	e5.05	1720	1.97	382	2.05	354
27, ...	......	240	....	290	3.00	678	2.83	610	1.56	235	0.50	64	0.17	36	0.37	52	3.22	773	‡4.17	1230	1.83	297	2.20	396
28, ...	......	240	....	290	3.92	1110	‡2.76	583	1.56	235	0.44	58	‡0.18	37	0.35	50	3.17	751	3.30	808	1.80	290	2.23	405
29, ...	......	240	....	290	a6.39	2540	2.68	553	1.48	218	0.42	56	0.19	37	0.27	44	‡2.82	606	3.30	808	1.55	233	‡2.21	399
30, ...	......	240	....	....	7.15	f3070	4.88	1620	1.83	297	‡0.47	61	0.39	53	0.27	44	2.47	480	2.55	507	1.65	255	2.20	396
31, ...	......	240	....	....	‡6.88	2530	......	....	1.68	262	......	....	0.27	44	0.17	36	.....	......	2.35	442	.....	.....	3.23	777

*Frozen. Discharge January 7th to March 12th, inclusive, estimated from Delaware River at Port Jervis and Lackawanna River at Scranton. †Ice went out at 3:00 a. m.

‡ Interpolated from gage heights and weather conditions.

a Max.—7.78 at 2:00 p. m.=f. 3600 sec. ft.

b Max.—7.98 at 6:30 a. m.=f. 3780 sec. ft.

c Max.—1.37 at 4:00 p. m.=196 sec. ft.

d Max.—4.52 at 4:30 p. m.=1420 sec. ft.

e Max.—5.95 at 6:15 a. m.=2260 sec. ft.

f Estimated.

ESTIMATED MONTHLY DISCHARGE OF LACKAWAXEN RIVER, AT HAWLEY, WAYNE COUNTY.

(Drainage area 290 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January	....	....	277	0.955	1.101
February, ...	....	....	290	1.000	1.079
March, ...	f3600	....	1164	4.014	4.628
April, ...	f3780	558	1180	4.069	4.540
May, ...	1340	218	641	2.210	2.548
June, ...	304	56	132	0.455	0.508
July, ...	72	36	52	0.179	0.207
August, ...	196	29	64	0.221	0.255
September, ...	1420	50	266	0.917	1.023
October, ...	2260	69	358	1.234	1.423
November, ...	764	194	301	1.038	1.158
December, ...	1490	214	566	1.952	2.250
The year, ...	....	....	441	1.520	20.720

Note: f Estimated.

From January 7th to March 12th inclusive no gage heights were observed and discharge for these dates was estimated from Delaware River at Port Jervis and Lackawanna River at Scranton.

WALLENPAUPACK CREEK.

DESCRIPTION OF BASIN.

Wallenpaupack creek, the largest and most important tributary of the Lackawaxen river, rises in the Pocono Plateau in the northern part of Monroe county, and flows in a general northeasterly direction forming the boundary between Pike and Wayne counties, for approximately 30 miles, to its mouth at Hawley, the total drainage area being 240 square miles, comprising 40 per cent. of the drainage area of the Lackawaxen river.

Its many tributaries quite generally rise in glacial lakes or swamps, and, falling rapidly, join the main stream, whose slope is very flat for many miles to within a mile of its mouth. Its source is at an approximate elevation of 2,100 feet, and for 17 miles the slope is very rapid, averaging 56 feet per mile to Ledgedale, 13 miles above the mouth. From Wilsonville, one mile above the mouth, it descends 285 feet to the Lackawaxen river over a series of falls and rapids, while above that point the fall is less than 10 feet in 12 miles, thus affording a fortunate combination for water storage and the generation of water power.

The valley below Ledgedale is wide and swampy, while the rolling hillsides are quite largely under cultivation. Along some of the tributaries, and in the main valley, is a certain amount of timber. The watershed is comparatively narrow for some 15 miles above its mouth, widening out above to follow its numerous upper tributaries in Wayne, Pike and Monroe counties. The drainage area is sparsely inhabited and contains practically no settlements.

The creek and its tributaries are not used for water supply purposes, and to a limited extent for water power below Wilsonville.

The average yearly rainfall over the watershed is approximately 43 inches.

The flow has been measured since July 3, 1908, at Wilsonville, one mile above the mouth.

DELAWARE BASIN—STATION NO. 4.

WALLENPAUPACK CREEK AT WILSONVILLE.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, July 3rd, 1908, on a two span, steel, through truss, highway bridge at Wilsonville, about one mile above the mouth, but gage readings were not commenced until June 1, 1909. A 12-foot staff gage is bolted to the downstream face of the center pier, the zero of the gage being arbitrary datum. Bench mark No. 1 is on a small projection on right abutment, downstream corner, 5.2 ft. down from bridge seat, the elevation being 3.923 feet above zero of gage. Bench mark No. 2 is highest point on round stone 3.3 feet from telegraph pole and 9.0 feet from downstream corner of right abutment; elevation 6.16 feet above zero of gage.

Discharge measurements are made from the downstream side of the bridge, and by wading at low stages. The initial point for soundings is top edge of bridge seat, left abutment, downstream side. The channel both above and below the station is straight. The right bank overflows for a space several hundred feet wide at high stages, but the left bank does not overflow. The bed is solid rock and permanent. The gage is read twice daily by Mrs. George Heickelbeck, except for the period of the year when flashboards are placed on the dam.

During low water, gage readings have to be discontinued on account of storage of water during the night by placing flashboards on a low dam 65 feet downstream from the gage. Changes in this dam have affected the gage heights from time to time, causing some uncertainty as to their accuracy.

Since the establishment of this station, ten discharge measurements have been made, four of which were taken with the flashboards on the dam. Owing to an insufficient number of discharge measurements, no rating curve has yet been determined, and therefore, only the discharge measurements and gage heights are published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WALLENPAUPACK CREEK, AT WILSONVILLE, WAYNE COUNTY, PENNA.

(Drainage area 240 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
10	July 1	Langenheim, ...	114	358	0.32	2.31	114	Surface measurement flash boards on dam.

DAILY MEAN GAGE HEIGHTS, IN FEET, OF WALLENPAUPACK CREEK, AT WILSONVILLE, WAYNE COUNTY, PA.

1912.	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	1.42	.85	1.60	2.60	2.25	1.10	....	1.75	1.82	1.42
2,	1.40	.80	1.50	2.50	2.18	1.10	....	1.46	1.70	1.42
3,	1.34	.80	1.35	2.55	1.98	1.15	....	1.25	1.60	2.08
4,	1.22	.80	1.26	2.60	1.90	1.15	....	1.20	1.50	2.40
5,	1.20	.75	1.18	2.40	1.78	1.05	....	1.20	1.45	2.35
6,	1.15	.75	1.15	2.30	1.70	1.00	....	1.15	1.40	2.30
7,	1.10	.70	1.10	2.20	1.72	1.00	....	1.10	1.40	2.26
8,	1.00	.70	1.10	2.10	1.78	1.00	....	1.10	1.72	2.22
9,	1.00	.70	1.25	2.15	1.88	1.00	....	1.10	1.96	2.18
10,	1.02	.70	1.45	2.06	2.02	.90	....	1.10	2.06	2.06
11,	1.00	.70	1.38	2.00	1.95	.90	....	1.18	1.95	1.96
12,	1.02	.66	1.35	1.85	1.78	.80	....	1.20	1.85	1.78
13,	1.00	.65	1.52	1.72	1.70	.80	....	1.26	1.75	1.58
14,	1.00	.65	2.05	1.70	1.62	.80	....	1.20	1.70	1.45
15,	.90	.62	2.30	1.80	1.58	.75	....	1.20	1.70	1.32
16,	.90	.60	2.82	1.72	1.50	.75	....	1.15	1.60	1.30
17,	.90	.60	3.10	1.70	1.65	.70	....	1.15	1.60	1.30
18,	.90	.65	2.60	1.75	1.82	.70	....	1.10	1.50	1.30
19,	.96	.68	2.35	1.98	1.78	.70	....	1.10	1.40	1.32
20,	1.12	.82	2.28	2.25	1.60	.70	....	1.06	1.30	2.08
21,	1.25	1.08	2.25	2.12	1.50	.65	....	1.00	1.25	2.18
22,	1.20	1.22	2.25	2.00	1.45	.60	....	1.00	1.25	2.06
23,	1.20	1.32	2.05	1.80	1.35	.60	....	1.20	1.26	1.85
24,	1.22	1.40	1.90	1.75	1.30	.60	....	2.12	1.32	1.76
25,	1.22	1.40	1.90	1.76	1.22	.60	2.20	3.05	1.42	1.70
26,	1.18	1.40	1.90	1.70	1.20	.55	3.05	3.35	1.50	1.65
27,	1.12	1.42	1.80	1.68	1.15	.55	3.00	3.10	1.55	1.55
28,	1.10	1.60	1.88	1.65	1.10	.50	2.62	2.60	1.50	1.65
29,	.95	1.62	2.15	1.65	1.05	.50	2.55	2.30	1.50	1.70
30,	.90	....	3.30	1.75	1.12	*	2.05	2.18	1.48	1.72
31,	.85	....	2.95	....	1.15	....	....	2.00	....	2.10

* Flash boards placed on dam. No readings taken June 30 to Sept. 24 inclusive.

SHOHOLA CREEK.

DESCRIPTION OF BASIN.

Shohola creek, a tributary of the Delaware river, and one of the largest joining that stream in Pike county, drains about 90 square miles of mountainous, forested and practically uninhabited territory in the northern portion of that county. It rises on the eastern slope of the Pocono mountains at an elevation of approximately 1,800 feet above sea level, in many lakes and ponds, abutting the watersheds of Bushkill, Wallenpaupack and Raymondskill creeks, and flows first in a general easterly direction through a glaciated country, with comparatively steep slopes, alternating with occasional swampy areas. About 12 miles above its mouth the stream turns to the northeast and enters a broad, flat, ancient lake bed, some five miles long, the maximum width being over one mile, lying at an elevation of approximately 1,150 feet above sea level. The current in this section of the stream is very sluggish and the valley flat and swampy. At the outlet of this swamp a low earth dam has been erected 10 or 15 feet high, which forms an extensive lake in the lower portion of the swamp, and is used for floating logs. Immediately below the outlet of the swamp the stream falls over a hard sandstone ledge, descending in an abrupt fall about 75 feet, and continuing for about 6 miles to its mouth through a steep and narrow valley, falling in this distance about 600 feet from the head of the falls to the Delaware river. For the most part this valley is wild and gorge-like and uninhabited, but near the mouth, are a few farms, where the valley widens, and at the mouth up on the river bluffs is the town and railroad station of Shohola.

The main tributaries are Rattlesnake Brook, coming in about two miles above the falls from the south, and draining about 13 square miles, and Greeley creek, coming in about two miles below the falls from the north, and draining about 15 square miles. The entire stream is at present unused, except for logging. The numerous lakes on the water shed, together with many springs which feed it, contribute to make a considerable flow throughout the dry seasons.

The average yearly rainfall over this watershed is approximately 43 inches.

The flow has been measured since September 22, 1911, at Lords Valley, 15 miles above the mouth, at which point the tributary drainage area is approximately 32 square miles.

Gaging Station on Shohola Creek at Lords Valley, Pike County.

SHOHOLA CREEK AT LORDS VALLEY.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, on September 22nd, 1911, on a single span, iron highway bridge. A standard chain gage is fastened to the upstream guard rail of the bridge. The length of chain is 13.00 feet from the bottom of weight to center of rivet, the elevation of zero being arbitrary datum. B. M. No. 1 is top stone of upstream corner of left abutment cut out with cross and B. M. cut in stone on top; elevation 9.90 feet above gage datum.

Discharge measurements are made from the downstream side of the bridge, or by wading, the initial point for soundings being the left end of downstream handrail. The channel both above and below the bridge is straight, but passes under it at a slight angle, with rock and gravel bottom, the right bank being high and not subject to overflow, while the left bank is only subject to overflow at extremely high stages. The gage is read twice daily by Oswald Vennie.

Since the establishment of the gage 3 discharge measurements have been made. Therefore, no rating curve has been determined, and only the discharge measurements and gage heights are published.

The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF SHOHOLA CREEK, AT LORDS VALLEY, PIKE COUNTY, PA.

(Drainage area 32 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
2	June 5	Gannett, ...	19	19	1.80	4.93	33.8	Wading measurement under bridge.
3	July 1	Langenheim, ...	20	15	0.77	4.45	11.6	Wading measurement 75 feet below bridge.

DAILY MEAN GAGE HEIGHTS OF SHOHOLA CREEK, AT LORDS VALLEY, PIKE COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	5.04	4.72	5.05	5.67	5.46	4.92	4.33	4.24	4.40	4.87	5.06	4.81
2,	*5.17	4.68	4.97	5.61	5.45	4.86	4.40	4.20	4.60	4.78	5.14	4.92
3,	5.03	4.76	4.96	5.85	5.39	4.85	4.37	4.28	4.53	4.77	5.04	5.52
4,	5.16	4.72	4.88	5.55	5.35	4.84	4.36	4.22	4.57	4.78	5.01	5.16
5,	5.03	4.87	4.83	5.51	5.28	4.85	4.49	4.20	4.42	4.67	4.94	5.10
6,	*5.56	4.72	4.88	5.59	5.35	4.87	4.43	4.18	4.42	4.60	4.92	5.17
7,	6.25	4.73	4.85	5.46	5.32	4.87	4.35	4.18	4.38	4.62	5.02	5.24
8,	6.85	4.73	4.87	5.49	5.52	4.80	4.32	4.20	4.90	4.60	4.55	5.10
9,	6.92	4.68	5.04	5.51	5.50	4.75	4.32	4.17	4.58	4.59	5.25	5.01
10,	†7.59	4.84	4.95	5.46	5.49	4.71	4.36	4.74	4.45	4.60	5.10	5.00
11,	7.53	4.88	4.95	5.40	5.31	4.62	4.33	5.40	4.39	4.69	5.06	4.99
12,	7.16	4.94	4.85	5.35	5.36	4.65	4.32	4.71	4.40	4.65	5.02	4.96
13,	7.15	4.94	5.64	5.41	5.43	4.65	4.31	4.50	4.36	4.66	5.02	5.10
14,	6.63	4.96	5.39	5.41	5.31	4.63	4.30	4.45	4.34	4.60	5.03	4.96
15,	5.97	5.00	5.63	5.37	5.32	4.61	4.32	4.38	4.35	4.57	5.08	4.90
16,	5.86	5.00	6.85	5.37	5.40	4.67	4.28	4.32	4.72	4.56	4.98	4.92
17,	5.26	5.00	5.70	5.33	5.80	4.61	4.28	4.26	4.44	4.54	4.94	4.86
18,	5.06	4.95	5.83	5.53	5.54	4.62	4.33	4.71	4.45	4.55	4.94	4.88
19,	5.44	4.42	5.85	5.55	5.50	4.59	4.31	4.67	4.52	4.56	4.89	5.56
20,	6.29	4.93	5.69	5.50	5.44	4.55	4.26	4.57	4.50	4.56	4.89	5.24
21,	5.70	4.94	5.47	5.45	5.33	4.55	4.26	4.46	4.40	4.53	4.82	5.08
22,	5.21	6.37	5.59	5.40	5.29	4.55	4.32	4.46	4.40	4.54	4.84	4.95
23,	5.02	6.60	5.52	5.39	5.28	4.52	4.28	4.41	4.44	5.22	4.82	‡4.96
24,	4.98	5.94	5.51	5.37	5.20	4.52	4.24	4.44	4.82	5.79	5.15	4.97
25,	5.53	5.26	5.49	5.33	‡5.12	4.49	4.22	4.32	5.56	5.74	5.20	4.91
26,	*6.08	5.20	5.47	5.33	5.07	4.52	4.23	4.31	5.47	5.60	5.04	*4.98
27,	6.03	5.30	5.47	5.31	5.00	4.48	4.22	4.27	5.28	5.48	4.95	5.04
28,	6.10	5.22	5.55	5.23	4.96	4.46	4.20	4.26	5.03	5.31	4.89	5.07
29,	4.99	5.06	6.37	5.35	4.96	4.47	4.25	4.28	5.41	5.20	4.86	5.05
30,	4.79	....	6.11	5.61	5.16	4.45	4.23	4.26	4.92	5.18	4.84	5.08
31,	4.82	....	5.71	....	5.02	....	4.23	4.11	....	5.06	....	5.52

*Rise caused by ice. †Creek blocked with anchor ice. ‡Interpolated.

RATTLESNAKE BROOK.

DESCRIPTION OF BASIN.

Rattlesnake Brook is one of the largest tributaries of Shohola creek, joining that stream about two miles above the falls, and about 8 miles above its mouth, coming in from the south and draining a wild and uninhabited area of about 13 square miles. The valley of this stream is flat and swampy for three or four miles above its mouth, then rises abruptly to its sources, which are at an elevation of about 1,600 feet above sea level, where it meets the headwaters of the Bushkill and Raymondskill creeks and flows in a general northerly direction to its mouth. The stream is approximately 8 miles long.

The average yearly rainfall over this watershed in from 40 to 45 inches.

The flow has been measured since September 22, 1911, at the crossing of the Spring Brook road about two miles above the mouth of the stream.

DELAWARE BASIN—STATION NO. 6.

RATTLESNAKE BROOK AT SPRING BROOK.

DESCRIPITON OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, September 22nd, 1911, at a single span, open wooden bridge, two miles above the mouth of Rattlesnake brook on the Spring Brook Road. A five-foot staff gage is fastened to the upstream side of the logs forming the right abutment, and the elevation of zero of the gage is zero of an arbitrary datum. B. M. No. 1 is on nail in root at base of swamp maple, 2 feet in diameter, 18 paces from center of bridge on right bank; nail in root facing road and nearest bridge, tree burned on side nearest road, also rotted on same side; elevation 4.05 feet above gage datum.

Discharge measurements are taken from the upstream side of the bridge, and by wading, while the initial point for soundings is the face of the logs forming the left abutment. The channel is straight for 30 feet above, and 80 feet below the station. Both banks are high and not subject to overflow, and the bed consists of gravel and mud. The gage is read twice daily by August Tampier.

Since the establishment of the gage four discharge measurements have been made. Therefore, no rating curve has been determined, and only the discharge measurements and gage heights are published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF RATTLESNAKE BROOK AT SPRING BROOK, PIKE COUNTY, PA.

(Drainage area, 11 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
2	June 5	Gannett, ...	16	35	0.42	1.55	15.1	Measurement from bridge.
3	July 1	Langenheim, ...	13	12	0.29	1.01	3.5	Wading measurement, 100 feet above bridge.
	1913							
4	Feb. 20	Boehringer & Knight,	16	34	0.27	1.40	9.2	Intergration method. 0.6 measurement.

DAILY MEAN GAGE HEIGHTS OF RATTLESNAKE BROOK, AT SPRING BROOK, PIKE COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	1.78	1.37	1.50	2.67	2.38	1.60	1.07	0.92	1.11	2.09	2.04	1.42
2,	1.74	1.34	1.48	2.62	2.30	1.53	1.07	0.92	1.40	1.94	2.19	1.45
3,	1.70	1.32	1.47	3.01	2.19	1.50	1.06	0.92	1.87	1.67	2.09	1.98
4,	1.70	1.32	1.46	2.70	2.00	1.53	1.04	0.98	1.20	1.44	1.99	1.96
5,	1.70	1.31	1.44	2.52	1.98	1.53	1.02	0.90	1.11	1.37	1.89	1.83
6,	1.69	1.30	1.40	2.44	1.96	1.52	1.00	0.90	1.05	1.29	1.86	1.83
7,	1.67	1.30	1.42	2.32	2.00	1.50	1.00	0.90	1.09	1.29	1.91	1.80
8,	1.64	1.28	1.44	2.38	2.10	1.50	1.00	0.90	1.61	1.29	2.51	1.78
9,	1.62	1.24	1.48	2.42	2.35	1.48	0.99	0.90	1.53	1.29	2.41	1.75
10,	1.60	1.22	1.45	2.34	2.00	1.45	1.00	1.50	1.42	1.27	2.31	1.76
11,	1.62	1.22	1.42	2.20	1.94	1.43	1.00	2.50	1.29	1.29	2.09	1.74
12,	1.60	1.20	1.44	2.06	1.89	1.39	0.99	2.38	1.17	1.29	1.94	1.74
13,	1.60	1.20	3.05	2.04	1.98	1.34	0.99	1.88	1.10	1.23	1.91	1.73
14,	1.61	1.20	3.00	2.03	1.96	1.30	0.99	1.32	1.09	1.19	1.89	1.73
15,	1.60	1.21	3.65	1.98	1.90	1.29	0.99	1.15	1.09	1.19	1.79	1.72
16,	1.57	1.21	3.72	1.98	2.10	1.30	0.99	1.10	1.31	1.17	1.79	1.70
17,	1.55	1.21	3.54	1.98	2.06	1.31	0.99	1.09	1.23	1.16	1.74	1.67
18,	1.53	1.22	3.15	2.25	2.00	1.28	0.99	1.13	1.18	1.09	1.69	1.68
19,	1.58	1.22	2.79	2.42	1.98	1.20	0.99	1.38	1.11	1.09	1.67	2.08
20,	1.59	1.23	2.59	2.40	1.90	1.20	0.99	1.42	1.09	1.07	1.64	2.03
21,	1.58	1.26	2.54	2.19	1.85	1.54	0.99	1.34	1.09	1.04	1.61	1.98
22,	1.61	1.30	2.46	2.13	1.82	1.18	1.00	1.30	1.08	1.08	1.59	1.93
23,	1.65	1.38	2.20	2.10	1.78	1.17	0.99	1.16	1.09	1.07	1.54	1.92
24,	1.64	1.44	2.26	2.14	1.76	1.14	0.99	1.20	1.31	a3.19	1.49	1.86
25,	1.63	1.46	2.36	2.08	1.70	1.10	0.99	1.18	2.24	3.26	1.49	1.82
26,	1.60	1.55	2.30	2.06	1.69	1.10	0.98	1.10	2.13	2.84	1.47	1.78
27,	1.58	1.61	2.44	1.98	1.67	1.10	0.95	1.06	2.09	2.57	1.43	1.73
28,	1.52	1.70	2.45	1.88	1.44	1.09	0.92	1.04	2.11	2.29	1.44	1.88
29,	1.47	1.70	3.32	1.88	1.46	1.08	0.92	1.00	2.05	2.09	1.44	1.89
30,	1.43	....	3.12	2.66	1.45	1.08	0.92	1.00	2.09	2.09	1.44	1.94
31,	1.40	....	2.78	....	1.55	....	0.92	1.00	....	1.99	....	2.04

aMaximum 3.39 at 4:00 p. m.

DELAWARE RIVER.

DESCRIPTION OF BASIN.

The Delaware river rises at an elevation of about 1,900 feet above sea level, in two branches, in the Catskill mountains of eastern New York, flowing southwesterly and uniting at Hancock on the New York-Pennsylvania boundary, at an elevation of 895 feet. From this point a general southerly course is followed to the mouth in Delaware Bay, the river forming the eastern boundary of Pennsylvania, and dividing it from New York for 60 miles and from New Jersey for 170 miles.

The total length of the river is approximately 410 miles, and its drainage area above the Pennsylvania-Delaware line is 10,900 square miles. The major tributaries are the Lackawaxen, Lehigh and Schuylkill rivers, and numerous large creeks from Pennsylvania; Neversink river from New York, and Flat Brook, Paulins Kill, Pequest, Lepatcong, Pohatcong and Muscenetong rivers from New Jersey.

Its upper section is in a mountainous, sparsely inhabited and well timbered region, continuing through northern Pennsylvania and New Jersey. After cutting through the Kittatinny ridge at Delaware Water Gap it emerges into the broader valley below, where the population becomes more dense, the land is largely cultivated and the timber less general.

Above Trenton, the head of tidewater, 30 miles above Philadelphia, the stream is generally swift and shallow, flowing on a rocky bed with numerous riffles and several considerable rapids. The slope from the northern boundary of New Jersey to Trenton is 3.5 feet per mile, and above this point to the Pennsylvania-New York line it averages 6 feet per mile. The upper section is in the once glaciated region and the tributaries drain numerous lakes, ponds and swamps throughout New York, upper Pennsylvania and New Jersey.

The stream is used considerably in its lower section for domestic and industrial supply in New Jersey and Pennsylvania, but the water power opportunities of the upper Delaware, although considerable, are undeveloped.

In Pennsylvania the cities of Philadelphia, Easton, and Chester lie on the river banks, while on tributaries are South Bethlehem, Allentown, Norristown, Pottstown, Reading, Pottsville and many smaller communities.

A portion of the anthracite coal region lies at the headwaters of the Schuylkill and Lehigh rivers, and a large limestone area is drained by the lower tributaries of these streams.

The Delaware basin in Pennsylvania is subject to an average annual precipitation of 46.1 inches, the upper part receiving 35 to 40 inches, and the major portion lying within the 45 to 50 inch zone. The area of highest precipitation in the State, 50 to 55 inches, lies at the headwaters of the Schuylkill river.

The flow is measured at Rieglesville, N. J., and Port Jervis, N. Y., the former since July 3, 1906, and the latter since October 12, 1904. A station was operated at Lambertville, N. J., from July 22, 1897, to April 1, 1908.

DELAWARE BASIN—STATION NO. 7.

DELAWARE RIVER AT PORT JERVIS, NEW YORK.

DESCRIPTION OF STATION.

This station was established by the United States Weather Bureau, October 12, 1904, on the two span, steel, through truss, toll, highway bridge between Port Jervis, New York and Matamoras, Pennsylvania. A standard chain gage is fastened to the railing on the right span, downstream side, near the pier. The length of chain from center of rivet to bottom of weight is 36.52 feet, and the elevation of zero of gage above mean sea level is 414.89 feet. There are three bench marks, as follows: B. M. No. 1 is a cross on door-sill of school house on Thompson street, near Water street, Port Jervis, at elevation of 27.75 feet above zero of gage; B. M. No. 2 is top of downstream left corner of pier of toll bridge, at elevation of 29.92 feet above zero of gage; B. M. No. 3 is top of right abutment of toll bridge at apex of angle caused by junction of downstream wingwall, at elevation of 29.02 feet above zero of gage.

Discharge measurements are made from either the upstream or downstream side of bridge, and the initial point for soundings is the top edge of bridge seat of Port Jervis abutment. The channel of the river above and below the station is straight, with high banks, which do not overflow, and a bed of permanent rocks and gravel. This gage is read once daily by Jacob Miller, toll collector at the bridge, and by co-operation with the Weather Bureau, weekly reports are received by the Water Supply Commission.

Considerable difficulty has been experienced in maintaining the data of the gage constant. September 4, 1908, a careful investigation was made and in order to avoid negative readings, a change in the original datum, as nearly as could be determined, of about 2 feet was made. A correction varying from 1.7 feet to 2.0 feet added to gage heights prior to September 4th, 1908, so that all gage heights published refer to the same datum.

The gaging section is affected by ice to greater or less extent each winter.

Since the establishment of this gage, 37 discharge measurements have been made. These measurements have been made by the United States Geological Survey, New York State Engineer, and the Water Supply Commission of Pennsylvania. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF DELAWARE RIVER, AT PORT JERVIS, N. Y.

(Drainage area 3,250 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
33	June 29	Langenheim, ...	511	1518	0.54	1.55	816	0.6 measurement.
34	July 29	Weber, ...	336	490	1.14	1.36	557	Wading measurement.
35	Nov. 22	Weber, ...	572	2190	1.31	3.01	2880	
	1913							
36	Feb. 21	Boehringer & Knight,	541	2022	1.21	2.66	2442	0.6 measurement.
37	March 8	....	......	....	....	3.05	2910	

DISCHARGE TABLE FOR DELAWARE RIVER, AT PORT JERVIS, N. Y., FROM JANUARY 1ST. TO DEC. 31ST., 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.70	180	.60	2080	.50	7700	.40	16810	.30	29720
.80	225	.70	2260	.60	8100	.50	17390	.40	30470
.90	275	.80	2450	.70	8510	.60	17990	.50	31220
1.00	330	.90	2650	.80	8930	.70	18600	.60	31970
.10	390	3.00	2860	.90	9350	.80	19220	.70	32720
.20	450	.10	3080	5.00	9780	.90	19850	.80	33480
.30	520	.20	3320	.10	10220	7.00	20500	.90	34240
.40	590	.30	3580	.20	10670	.10	21160	9.00	35000
.50	665	.40	3860	.30	11130	.20	21830	.10	35770
.60	740	.50	4150	.40	11590	.30	22510	.20	36540
.70	825	.60	4450	.50	12060	.40	23200	.30	37310
.80	920	.70	4770	.60	12540	.50	23900	.40	38090
.90	1030	.80	5100	.70	13030	.60	24610	.50	38870
2.00	1150	.90	5440	.80	13540	.70	25320	.60	39650
.10	1280	4.00	5800	.90	14060	.80	26040	.70	40430
.20	1420	.10	6160	6.00	14590	.90	26770	.80	41220
.30	1570	.20	6530	.10	15130	8.00	27500	.90	42010
.40	1730	.30	6910	.20	15680	.10	28240	10.00	42800
.50	1900	.40	7300	.30	16240	.20	28980		

Note. This table is only applicable subsequent to January 1, 1912, and is based on three discharge measurements made during 1911 and 1912 together with the former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF DELAWARE RIVER, AT PORT JERVIS, NEW YORK.

1912.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.9	5440	....	3330	....	5820	7.5	23900	6.2	15700	3.2	3320	1.5	665	1.4	590	2.0	1150	2.9	2650	4.6	8100	3.0	2860
2, ...	3.9	5440	....	3330	....	5820	7.8	26000	5.6	12500	3.3	3580	1.5	665	1.3	520	2.3	1570	2.7	2260	3.5	4150	2.9	2650
3, ...	3.7	4770	....	3330	....	5820	10.2	44400	5.2	10700	3.5	4150	1.4	590	1.3	520	3.3	3580	2.6	2060	3.7	4770	3.2	3320
4, ...	3.4	3860	....	3330	....	5820	8.7	32700	4.8	8930	3.2	3320	1.4	590	1.3	520	3.3	3580	2.6	2060	3.7	4770	6.8	19700
5, ...	3.3	3580	....	3330	....	5820	7.2	21800	4.6	8100	3.1	3080	1.2	450	1.2	450	3.0	2860	2.5	1900	3.3	3580	6.0	14600
6, ...	2.9	2650	....	3330	....	5820	6.4	16800	4.2	6530	2.9	2650	1.4	590	1.1	390	3.0	2860	2.3	1570	3.2	3320	5.0	9780
7, ...	2.7	2260	....	3330	....	5820	6.3	16200	4.4	7300	3.5	4150	1.3	520	1.3	520	2.8	2450	2.2	1420	3.0	2860	6.1	15100
8, ...	2.5	1900	....	3330	....	5820	7.2	21800	4.4	7300	3.1	3080	1.4	590	1.3	520	2.6	2080	2.2	1420	3.4	3860	5.5	12100
9, ...	2.7	2260	....	3330	....	5820	7.5	23900	5.0	9780	2.9	2650	1.3	520	1.4	590	2.5	1900	2.1	1280	5.9	14100	5.0	9780
10, ...	2.7	2260	....	3330	....	5820	6.3	16200	4.9	9350	2.7	2260	1.3	520	1.4	590	2.4	1730	2.1	1280	5.1	10200	4.6	8100
11, ...	3.0	2860	....	3330	....	5820	5.8	13500	4.6	8100	2.6	2060	1.3	520	3.2	3320	2.2	1420	2.1	1280	4.8	8930	4.3	6910
12, ...	3.0	2860	....	3330	....	5820	5.5	12100	4.5	7700	2.5	1900	1.2	450	2.5	1900	1.8	920	2.1	1280	4.6	8100	4.1	6160
13, ...	....	2700	....	3330	...	5820	5.2	10700	4.2	6530	2.4	1730	1.5	665	2.9	2650	1.8	920	2.1	1280	4.0	5800	3.9	5140
14, ...	....	2700	....	3330	6.0	14600	5.3	11100	4.1	6160	2.3	1570	1.4	590	2.5	1900	1.7	825	2.0	1150	3.9	5440	3.6	4450
15, ...	....	2700	....	3330	6.3	16200	5.0	9780	4.0	5800	2.3	1570	1.3	520	2.2	1430	1.6	740	2.1	1280	3.9	5440	3.3	3580
16, ...	....	2700	....	3330	10.2	44400	5.4	11600	3.8	5100	2.3	1570	1.6	740	2.0	1150	1.5	665	2.0	1150	3.6	4450	3.0	2860
17, ...	....	2700	....	3330	9.1	35800	7.8	26000	4.8	8930	2.3	1570	1.6	740	2.0	1150	1.9	1080	2.0	1150	3.5	4150	3.5	4150
18, ...	....	2700	....	3330	7.6	24600	7.1	21200	5.1	10200	2.2	1420	2.0	1150	2.1	1280	2.0	1150	1.9	1080	3.3	3580	3.3	3580
19, ...	....	2700	....	3330	7.6	24600	8.2	29000	4.8	8930	2.2	1420	2.0	1150	2.3	1570	2.0	1150	1.9	1080	3.1	3060	3.4	3860
20, ...	....	2700	....	3330	7.3	22500	8.1	28200	4.5	7700	2.1	1280	2.3	1570	2.5	1900	2.1	1280	1.9	1080	3.0	2860	4.8	8930
21, ...	....	2700	....	3330	7.2	21800	7.8	26000	4.1	6160	2.0	1150	1.8	920	2.4	1730	2.2	1420	1.9	1080	3.0	2860	4.3	6910
22, ...	....	2700	....	3330	6.0	14600	6.1	15100	3.9	5440	2.0	1150	1.8	920	2.3	1570	2.2	1420	1.9	1080	3.0	2860	4.3	6910
23, ...	....	2700	....	3330	5.7	13000	5.7	13000	3.9	5440	1.9	1080	1.8	920	2.6	2060	2.0	1150	2.0	1150	2.9	2650	3.9	5140
24, ...	....	2700	....	3330	5.3	11100	5.6	12500	3.6	4450	1.8	920	1.6	740	2.8	2450	2.0	1150	4.8	8930	2.8	2450	3.7	4770
25, ...	....	2700	....	3330	5.2	10700	5.1	10200	3.6	4450	1.8	920	1.6	740	3.1	3080	3.2	3320	7.5	23900	3.2	3320	3.7	4770
26, ...	....	2700	....	3330	5.0	9780	4.9	9350	3.5	4150	1.7	825	1.5	665	3.0	2860	4.3	6910	6.5	18400	3.6	4450	3.5	4150
27, ...	....	2700	....	3330	4.5	7700	4.7	8510	3.3	3580	1.6	740	1.4	590	2.8	2450	4.0	5800	5.4	11600	3.5	4150	3.5	4150
28, ...	....	2700	....	3330	4.6	8100	4.6	8100	3.0	2860	1.6	740	1.3	520	2.5	1900	3.7	4770	4.8	8930	3.4	3860	3.7	4770
29, ...	....	2700	....	3330	6.3	16200	4.4	7300	2.8	2450	1.5	665	1.3	520	2.4	1730	3.3	3580	4.5	7700	3.3	3580	3.5	4150
30, ...	....	2700	....	......	10.6	47600	7.0	20300	3.1	3080	1.5	665	1.4	590	2.3	1570	3.2	3320	4.2	6530	3.1	3080	3.4	3860
31, ...	....	2700	....	......	8.2	29000	....	......	3.3	3580	....	......	1.4	590	2.1	1280	....	......	4.4	7300	....	......	4.3	6910

Note.—Ice conditions January 13 to March 13, inclusive. Mean daily discharge estimated by comparison with Delaware River at Riegelsville, N. J.

ESTIMATED MONTHLY DISCHARGE OF DELAWARE RIVER, AT PORT JERVIS, N. Y.

(Drainage area 3,250 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	2950	0.914	1.05
February,	....	....	3330	1.02	1.10
March,	47600	....	14400	4.43	5.11
April,	44400	7300	18200	5.60	6.25
May,	15700	2450	7000	2.15	2.48
June,	4150	665	1910	0.588	0.66
July,	1570	450	694	0.214	0.25
August,	3320	390	1490	0.458	0.53
September,	6910	665	2220	0.683	0.76
October,	23900	1080	4040	1.24	1.43
November,	14100	2450	4830	1.49	1.66
December,	19200	2650	6590	2.03	2.34
The year,	47600	390	5640	1.74	23.62

Note. Ice conditions January 13 to March 18 inclusive. Mean daily discharge estimated by comparison with Delaware River at Riegelsville, N. J.

BIG BUSHKILL CREEK.

DESCRIPTION OF BASIN.

Big Bushkill creek, a large tributary of the Delaware river in Monroe and Pike counties, drains an area of approximately 150 square miles. Rising in many lakes and ponds on the Pocono Plateau, in the south central part of Pike county, it flows southerly through an uninhabited region covered with heavy second growth and some virgin timber, to within a few miles of its mouth at Bushkill, the length being approximately 25 miles. The principal tributaries are Wells, Middle Bushkill and Little Bushkill creeks, the watershed including numerous lakes, ponds and swamps, and lying entirely within the glacial area. On Bushkill creek and its tributaries are numerous falls, and rapids, most noted of which are Bushkill Falls on Little Bushkill creek, and Winona Falls on the main stream, all the streams being rapid below the falls, flowing over rocky beds within steep, precipitous banks, while above the slopes flatten and swampy areas abound. Bushkill village, at its mouth, is the only town within this basin. This creek and its tributaries are used to some extent on the lower reaches for power purposes by grist mills, while sites for considerable powers are as yet undeveloped.

The average yearly rainfall over this watershed is from 45 to 50 inches. The flow has been measured since September 19, 1908, at Shoemakers, 3 miles above the mouth.

DELAWARE BASIN—STATION NO. 8.

BIG BUSHKILL CREEK AT SHOEMAKER'S.

DESCRIPTION OF STATION.

This station was established on September 19, 1908, by the Water Supply Commission of Pennsylvania, on a single span, steel through-truss, highway bridge near Shoemaker's, 2 miles upstream from the village of Bushkill. A standard chain gage is fastened to the guard rail on the upstream side of the bridge. The length of chain from center of rivet to bottom of weight is 14.42 feet.

Discharge measurements are made from the downstream side of the bridge, and by wading above and below at low stages. The initial point for soundings is left end of handrail on downstream side of bridge. The bench mark is a point on the upstream corner of left abutment, top of fifth course from bottom, or eighth course from top, which is 5.625 feet above arbitrary zero of gage. The channel is straight for about 300 feet above and 800 feet below the bridge, the bottom being gravelly with some large rocks, and fairly permanent. Saw creek enters from the left a few hundred feet above the bridge. The gage is read once daily by George Beaver.

Since the establishment of the gage, ten discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BIG BUSHKILL CREEK, AT SHOEMAKER'S, MONROE COUNTY, PENNA.

(Drainage area 115 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
10	1912 June 26	Langenheim, ...	62	57	0.87	1.36	50	0.6 measurement.

DISCHARGE TABLE FOR BIG BUSHKILL CREEK, AT SHOEMAKER'S, MONROE COUNTY, FROM SEPTEMBER 19, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.90	6	.70	128	.60	529	.40	1237	.20	2115
1.00	12	.80	160	.70	596	.50	1346	.30	2225
.10	20	.90	195	.80	672	.60	1455	.40	2335
.20	31	2.00	233	.90	750	.70	1565	.50	2445
.30	44	.10	273	3.00	838	.80	1675	.60	2555
.40	60	.20	317	.10	928	.90	1785	.70	2665
.50	79	.30	364	.20	1025	4.00	1895	.80	2775
.60	102	.40	415	.30	1130	.10	2005	.90	2885
		.50	469					5.00	2995

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF BIG BUSHKILL CREEK, AT SHOEMAKERS, MONROE CO., PA.

1912.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	2.11	277	....	70	....	350	3.05	883	2.60	529	2.03	245	1.30	44	1.05	16	1.20	31	1.90	195	2.35	390	1.70	128
2,	2.03	245	....	70	....	350	2.90	750	2.53	487	1.95	214	1.25	38	1.18	29	1.70	128	1.82	167	2.26	345	2.20	317
3,	2.16	299	....	70	....	350	3.00	838	2.35	390	1.90	195	1.25	38	1.30	44	1.65	115	1.78	154	2.22	326	2.30	364
4,	2.11	277	....	70	....	350	2.85	711	2.30	364	1.80	160	1.23	35	1.20	31	1.55	90	1.70	128	2.18	308	2.22	326
5,	2.24	336	....	70	....	350	2.65	562	2.25	340	1.76	147	1.20	31	1.08	18	1.47	78	1.66	118	2.10	273	2.15	295
6,	....	125	....	70	....	350	2.50	469	2.37	400	1.70	128	1.28	41	1.05	16	1.40	60	1.60	102	2.05	253	2.28	355
7,	....	125	....	70	....	350	2.50	469	2.40	415	1.80	160	1.24	36	1.00	12	1.35	52	1.58	97	2.00	233	2.35	390
8,	....	125	....	70	....	350	2.55	499	2.60	529	1.72	134	1.18	29	0.95	9	1.65	115	1.55	90	2.33	379	2.22	326
9,	....	125	....	70	....	350	2.82	374	2.78	657	1.60	102	1.15	26	0.95	9	1.60	102	1.52	84	2.28	355	2.10	273
10,	....	125	....	70	....	350	2.30	364	2.62	542	1.54	88	1.10	20	1.08	14	1.52	84	1.46	71	2.20	317	2.08	245
11,	....	125	....	70	....	350	2.28	355	2.45	442	1.45	70	1.20	31	2.30	364	1.45	70	1.40	60	2.10	273	2.00	233
12,	....	125	....	70	....	350	2.25	340	2.37	400	1.45	70	1.20	31	2.00	233	1.40	60	1.33	49	2.05	253	1.97	222
13,	....	125	....	70	....	350	2.25	340	2.30	364	1.45	70	1.15	26	1.75	144	1.30	44	1.58	97	2.05	253	1.93	206
14,	....	125	....	70	....	350	2.23	331	2.25	340	1.38	57	1.15	26	1.55	90	1.23	35	1.55	90	2.18	308	1.90	196
15,	....	125	....	70	3.80	1680	2.18	308	2.23	331	1.35	52	1.12	22	1.50	79	1.18	29	1.50	79	2.10	273	1.90	195
16,	....	125	....	70	3.65	1510	2.15	295	2.18	308	1.50	79	1.10	20	1.38	57	1.70	128	1.48	75	2.05	253	1.88	188
17,	....	125	....	70	3.35	1180	2.15	295	2.90	750	1.55	90	1.15	26	1.30	44	1.65	115	1.45	70	2.00	233	1.85	178
18,	....	125	....	70	3.30	1130	2.45	442	2.80	672	1.42	64	1.12	22	1.45	70	1.60	102	1.40	60	1.93	206	1.80	160
19,	....	125	....	70	3.20	1020	2.70	596	2.55	499	1.35	52	1.10	20	1.58	97	1.78	154	1.40	60	1.86	181	2.15	296
20,	....	125	....	70	3.05	883	2.50	469	2.42	426	1.35	52	1.08	18	1.50	79	1.60	102	1.45	70	1.82	167	2.20	317
21,	....	125	....	375	2.80	672	2.40	415	2.30	364	1.33	49	1.20	31	1.38	57	1.55	90	1.48	75	1.80	160	2.12	282
22,	....	125	....	375	2.68	582	2.38	405	2.25	340	1.30	44	1.18	29	1.30	44	1.53	86	1.42	64	1.75	144	2.08	245
23,	....	125	....	375	2.53	487	2.38	405	2.20	317	1.29	43	1.15	26	1.45	70	1.50	79	1.70	128	1.75	144	1.95	214
24,	....	125	....	375	2.60	529	2.32	374	2.18	308	1.28	41	1.15	26	1.38	57	1.50	79	2.90	750	2.00	233	2.00	233
25,	....	125	....	375	2.52	481	2.26	345	2.10	273	1.26	39	1.12	22	1.30	44	2.15	295	3.00	838	2.15	295	2.06	253
26,	....	125	....	375	3.52	481	2.20	317	2.07	261	1.25	38	1.10	20	1.25	38	2.40	415	2.70	596	2.08	245	2.18	308
27,	....	125	....	375	2.48	458	2.15	295	1.98	225	1.23	35	1.10	20	1.20	31	2.33	379	2.50	469	2.00	233	2.36	395
28,	....	125	....	375	2.45	442	2.15	296	1.93	206	1.20	31	1.08	18	1.18	29	2.18	308	2.40	415	1.95	214	2.22	326
29,	....	125	....	375	3.30	1130	2.12	283	2.00	233	1.20	31	1.12	22	1.15	26	2.08	245	2.28	355	1.82	167	2.15	295
30,	....	125	....	......	3.25	1060	2.70	596	2.00	233	1.23	41	1.10	20	1.12	22	1.96	218	2.20	317	1.76	147	2.10	273
31,	....	125	....	......	3.15	976	....	......	2.05	253	....	......	1.05	16	1.06	16	....	......	2.06	257	....	......	2.40	415

Creek frozen January 6 to March 14, inclusive. Discharge estimated from Lehigh River at South Bethlehem.

ESTIMATED MONTHLY DISCHARGE OF BIG BUSHKILL CREEK, AT SHOEMAKERS, MONROE COUNTY, PA.

(Drainage area, 115 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	151	1.313	1.514
February,	....	....	165	1.435	1.548
March,	1680	....	633	5.504	6.345
April,	883	282	447	3.887	4.337
May,	750	206	393	3.417	3.939
June,	245	31	87	0.757	0.845
July,	44	16	27	0.235	0.271
August,	364	9	61	0.530	0.611
September,	415	29	129	1.122	1.252
October,	538	49	199	1.730	1.994
November,	390	144	252	2.191	2.444
December,	415	128	272	2.365	2.726
The year,	1680	9	235	2.040	27.826

Note. Creek frozen January 6 to March 14, inclusive. Discharge estimated from Lehigh River at South Bethlehem.

BRODHEADS CREEK.

DESCRIPTION OF BASIN.

Brodheads creek, a tributary of the Delaware river, in the central part of Monroe county, and one of the largest streams therein, drains approximately 285 square miles. Rising in the Pocono mountains, in the northwestern corner of Barrett township, it follows a southerly course through a sparsely inhabited area covered with second growth timber at its headwaters, thence through an agricultural region, to its mouth one mile above Delaware Water Gap, its total length being approximately 28 miles. Its source is at an elevation of about 2,000 feet above sea level, and its mouth 290 feet. The principal tributaries are Analomink, or Holler creek, McMichaels and Marshall creeks, the watershed including numerous small lakes, ponds and swamps, the stream lying entirely within the glacial area, while on it and its tributaries are numerous falls and rapids. The main stream is rapid, flowing over a rocky bed, between unusually steep banks, and is generally in a narrow valley except near the headwaters where the valleys widen and the slopes are more gradual. In this drainage basin lie the principal boroughs and villages of the

Gaging Station on Brodheads Creek at Analomink, Monroe County.

county, several of which obtain water supplies from the creek or its tributaries. Brodheads creek and its affluents are used to some extent for power purposes, while available sites are as yet undeveloped.

The average yearly rainfall over this watershed is from 45 to 50 inches.

The flow of this stream has been measured since September 17, 1908, at Analomink, 9 miles above the mouth.

DELAWARE BASIN—STATION NO. 9.

BRODHEADS CREEK AT ANALOMINK.

DESCRIPTION OF STATION.

This station was established on September 17, 1908, by the Water Supply Commission of Pennsylvania, on a single span, steel, through-truss, highway bridge, about one-quarter mile above the village of Analomink, but gage readings were not commenced until December 10, 1908. A 14-foot staff gage is bolted to the downstream face of the left abutment. A bench mark is located on the top of a reddish stone in the left abutment, bottom course, outer downstream corner, and the elevation is 2.11 feet above the arbitrary zero of the gage.

Discharge measurements are made from the downstream side of the bridge, or at low stages by wading above the bridge. The initial point for soundings is top angle of downstream handrail at left end, which is called station 2.3 feet. The channel above is straight for 100 feet, and below for 300 feet. A wooden dam 1,000 feet downstream backs the water up to within a short distance of the bridge. The left bank is high and does not overflow, but at extreme stages the right bank overflows and water passes across the road at right end of the bridge. The bed is mostly solid rock, and permanent, containing a large projecting ledge of rock near the left bank. The gage is read twice daily by Wilbur Imbt.

Since the establishment of this station, nine discharge measurements have been made. Owing to an insufficient number of discharge measurements, no rating curve has yet been determined, and, therefore, only the discharge measurements and gage heights are published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BRODHEADS CREEK, AT ANALOMINK, MONROE COUNTY, PA.

(Drainage area 120 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
9	1912 June 26.	Langenheim, ...	35	63	1.41	0.90	89	Wading msmt. 300′ above bridge. Intergration msmt.

DAILY MEAN GAGE HEIGHTS OF BRODHEADS CREEK, AT ANALOMINK, MONROE COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	2.00	1.92	2.52	3.15	2.75	1.45	0.60	0.80	1.12	1.37	2.02	1.60
2,	2.05	1.82	2.25	2.98	2.62	1.38	0.60	0.80	1.15	1.32	1.91	1.57
3,	2.00	1.79	2.15	3.25	2.42	1.30	0.60	0.80	1.16	1.28	1.88	1.52
4,	1.92	1.70	1.95	2.92	2.18	1.30	0.85	0.78	1.16	1.21	1.85	1.48
5,	1.72	1.80	1.82	2.75	2.02	1.30	1.20	0.72	1.22	1.21	1.81	2.95
6,	1.70	1.80	1.70	2.70	2.20	1.35	1.30	0.69	1.20	1.20	1.75	2.70
7,	1.60	1.80	1.65	2.58	2.18	1.40	0.95	0.66	1.20	1.17	2.35	2.42
8,	2.90	1.80	1.68	2.40	3.20	1.32	0.88	0.65	1.20	1.16	2.58	2.25
9,	2.70	1.80	1.88	2.25	2.70	1.23	0.85	0.85	1.19	1.15	3.42	2.16
10,	2.70	1.75	1.85	2.15	2.50	1.19	0.90	1.05	1.16	1.11	2.25	2.08
11,	2.70	1.75	1.60	2.00	2.38	1.14	0.98	1.48	1.15	1.20	2.18	2.01
12,	2.65	1.75	1.65	2.05	2.28	1.10	0.88	1.42	1.11	1.24	2.08	1.93
13,	2.62	1.70	4.15	2.12	2.30	1.09	0.82	1.40	1.08	1.20	1.99	1.86
14,	2.50	1.70	2.48	2.10	2.15	1.06	0.82	1.32	1.00	1.19	2.08	1.79
15,	2.70	1.70	b5.50	1.78	2.00	1.00	0.80	1.22	0.92	1.19	1.92	1.74
16,	2.70	1.70	4.65	1.70	3.30	1.18	1.02	1.18	1.12	1.16	1.79	1.66
17,	2.50	1.72	3.80	2.00	3.35	1.18	1.00	0.92	1.08	1.11	1.72	1.58
18,	2.55	1.76	3.60	2.95	2.90	1.15	0.90	1.20	1.03	1.10	1.69	2.42
19,	3.08	1.70	3.52	2.95	2.68	1.09	0.95	1.32	1.22	1.10	1.66	2.41
20,	3.00	1.70	3.15	2.88	2.58	1.06	1.06	1.25	1.15	1.10	1.56	2.18
21,	2.98	1.68	3.00	2.65	2.82	1.00	1.00	1.25	1.04	1.08	1.49	1.95
22,	2.12	a6.15	3.00	2.38	2.05	0.99	0.89	1.30	0.92	2.75	1.45	1.78
23,	2.10	4.75	3.10	2.30	1.90	0.92	0.82	1.28	0.95	3.15	1.40	1.70
24,	2.10	3.80	3.02	2.18	1.90	0.84	0.80	1.18	1.50	3.15	2.05	1.64
25,	2.10	3.10	3.00	2.05	1.88	0.79	0.80	1.15	2.30	2.90	1.99	1.60
26,	2.10	3.55	2.92	2.12	1.78	0.74	0.81	1.09	2.01	2.58	1.95	1.52
27,	2.12	3.28	2.85	2.18	1.70	0.70	0.74	1.08	1.85	2.12	1.90	1.75
28,	2.10	2.95	2.80	2.10	1.68	0.66	0.70	1.00	1.78	2.02	1.82	2.12
29,	2.10	2.80	4.15	2.50	1.75	0.65	0.70	0.92	1.49	1.94	1.79	1.78
30,	2.04	....	3.40	3.05	1.68	0.62	0.70	0.85	1.45	1.82	1.68	2.65
31,	2.00	....	3.40	....	1.58	....	0.80	0.98	....	2.00	....	2.82

a—Max. 6.30 at 9:00 a. m.
b—Max. 6.80 at 4:00 p. m.

POCONO CREEK.

DESCRIPTION OF BASIN.

Pocono creek, the largest tributary of McMichaels creek, lies in the south central part of Monroe county, draining an area of approximately 42 square miles. It rises in the Pocono mountains in the central part of the county, flowing in a general southerly direction through an uninhabited area, covered with second growth timber, to a point about six miles west of Stroudsburg, where it turns to an easterly direction through a farming section, to its mouth in the center of the town, a total distance of approximately 12 miles. In its upper sections the slope of the stream is steep, while in the lower section it is much flatter, and it lies entirely within the glacial area. A few grist mills operated by water-power exist on the lower sections of this creek. The average yearly rainfall over this watershed is from 45 to 50 inches.

The flow has been measured since August 3, 1911, at the Spoke Factory Bridge, near Stroudsburg, 2 miles above the mouth.

DELAWARE BASIN—STATION NO. 10.

POCONO CREEK NEAR STROUDSBURG.

DESCRIPTION OF STATION.

This station was established August 3, 1911, by the Water Supply Commission of Pennsylvania, on a single span, covered, wooden bridge about two miles above Stroudsburg, and is being maintained by Meikleham & Dinsmore, Engineers, New York City. A standard chain gage is fastened to the upstream guard rail of the bridge near the left bank. The length of chain from center of rivet to bottom of weight is 14.00 feet. Bench mark No. 1 is a large staple on the inside of the right upstream one of a pair of angling wooden braces, elevation 15.73 feet above zero of gage. Bench mark No. 2 is top of flat stone on top of face of left abutment, near upstream corner, below angle between upstream side of wooden bridge and end of wingwall guard wall, about 10 inches from side of bridge, elevation 10.67 feet above zero of gage.

Gaging Station on Pocono Creek above Stroudsburg.

Discharge measurements are made from the downstream side of bridge, and by wading under the bridge. The initial point for soundings is face of downstream abutment, right end. The channel above the bridge curves gently to the right for 600 feet, and below it is straight for 450 feet. The banks are high and rarely overflow except during extreme stages. The bed is of gravel and small stones. The gage is read twice daily by George K. Brands.

Since the establishment of this station, five discharge measurements have been made. Owing to the insufficient number of discharge measurements, no rating curve has been computed at this station, and only the discharge measurements and daily gage heights are published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF POCONO CREEK, NEAR STROUDSBURG, MONROE COUNTY, PA.

(Drainage area 38 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
5	1912 June 25,	Langenheim, ...	24	22	1.19	2.10	27	Wading msmt. 100 ft. below bridge intergration method.

DAILY MEAN GAGE HEIGHTS OF POCONO CREEK, NEAR STROUDSBURG, MONROE COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	2.96	2.50	3.38	3.89	3.35	2.50	2.48	1.78	2.07	2.47	2.79	2.58
2,	2.92	2.48	3.31	3.94	3.33	2.42	2.06	1.80	2.25	2.41	2.92	2.78
3,	2.94	2.51	3.21	4.04	3.24	2.48	2.10	2.06	2.17	2.39	2.78	3.38
4,	2.94	2.49	2.95	3.91	3.04	2.44	2.04	1.88	2.12	2.31	2.74	3.12
5,	2.93	2.44	‡2.89	3.78	3.06	2.49	1.98	1.78	2.17	2.27	2.69	f2.98
6,	2.94	2.40	‡2.75	3.57	3.05	2.44	2.06	1.83	2.12	2.82	2.62	....
7,	2.94	2.39	b2.81	3.39	3.14	2.37	1.95	1.86	2.09	2.25	3.05	....
8,	2.92	*2.37	2.81	3.43	4.04	2.36	1.99	1.88	2.02	2.27	3.48	....
9,	2.91	2.34	2.91	3.45	3.74	2.29	1.98	1.88	2.12	2.15	3.19	....
10,	2.94	2.42	2.81	3.17	3.57	2.30	2.05	2.10	2.10	2.22	3.07	....
11,	*2.90	2.34	2.85	3.11	3.40	2.36	2.03	2.30	2.08	2.42	3.01	g2.86
12,	*2.72	2.35	2.82	3.05	3.39	2.29	2.04	2.50	2.05	2.32	2.95	2.77
13,	*2.58	2.41	4.93	2.98	3.40	2.28	2.09	2.28	2.09	2.32	2.86	2.81
14,	2.55	2.40	4.51	2.98	3.35	2.18	2.26	2.15	1.90	2.31	2.94	2.78
15,	2.55	2.42	c5.49	2.98	3.25	2.24	2.15	2.08	1.95	2.26	2.77	2.70
16,	2.56	*2.43	5.44	2.99	d3.79	2.28	2.16	2.06	2.35	2.33	2.65	2.72
17,	2.55	2.44	4.41	3.00	4.01	2.29	2.33	2.20	2.15	2.25	2.66	2.64
18,	2.56	2.42	4.29	3.98	3.80	2.26	2.24	2.38	2.07	2.27	2.69	2.58
19,	2.98	2.45	4.04	3.84	3.59	2.18	2.20	2.23	2.19	2.21	2.61	3.41
20,	3.05	2.62	4.03	3.65	3.43	2.19	2.10	2.33	2.16	2.17	2.58	2.91
21,	2.98	2.72	3.98	3.41	3.24	2.14	2.10	2.36	2.13	2.23	2.56	2.76
22,	2.94	a4.78	3.81	3.35	3.08	2.20	2.18	2.40	2.15	e3.16	2.58	2.78
23,	†2.90	3.50	3.71	3.27	3.11	2.17	2.14	2.29	2.17	3.51	2.57	2.71
24,	2.92	3.12	3.74	3.19	3.08	2.19	2.02	2.17	2.37	3.46	3.17	2.66
25,	2.90	3.24	3.89	3.18	3.01	2.14	2.03	2.13	3.87	3.29	2.89	f2.78
26,	2.90	3.40	3.75	3.11	2.91	2.18	2.02	2.13	2.89	3.05	2.93	....
27,	2.82	4.26	3.61	3.18	2.78	2.13	1.96	2.14	2.67	2.97	2.79	....
28,	2.76	3.78	3.78	3.17	2.71	2.10	1.88	2.06	2.59	2.95	2.79	....
29,	2.70	3.42	4.50	3.29	2.64	2.14	1.91	2.08	2.55	2.79	2.77	....
30,	2.59	....	4.35	3.45	2.75	2.48	1.95	2.10	2.45	2.67	2.65	....
31,	2.53	....	4.04	....	2.59	....	1.90	2.16	....	2.69	....	....

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* Stream partly frozen. ‡ Stream blocked with ice. † Stream partly blocked with ice. a Maximum 4.82 at 8:30 A. M. b Channel open. c Maximum 5.99 at 4:15 P. M. d Maximum 4.34 at 4:15 P. M. e Maximum 3.97 at 4:15 P. M. f Gage stolen during P. M. g Gage re-established.

McMICHAELS CREEK.

DESCRIPTION OF BASIN.

McMichaels creek, the largest tributary of Brodheads creek, lies in the south central part of Monroe county, draining an area of approximately 105 square miles. It rises in the Pocono mountains, flows first in a southerly direction through an uninhabited area covered with second growth, and thence turns easterly through a sparsely inhabited agricultural region, to its mouth a short distance below Stroudsburg, a distance of approximately 20 miles. In its upper section the slope of the creek is steep, while in the lower section it is much flatter, and it lies entirely within the glacial area. Pocono creek, with a drainage area of approximately 42 square miles, is the largest tributary, while several lakes and ponds lie within its watershed. A few grist mills operated by water power exist in the lower section of the creek and its tributaries.

The average yearly rainfall over this watershed is from 45 to 50 inches.

The flow has been measured at two points; namely, at the Seventh Street Viaduct, Stroudsburg, from September 16, 1908, to July 16, 1910, at which time the station was discontinued, and at the railroad bridge near the car shops above Stroudsburg since August 3, 1911. The first station was a short distance below the mouth of Pocono creek, whereas the present station is about one mile above the mouth of Pocono creek.

DELAWARE BASIN—STATION NO. 11.

McMICHAELS CREEK AT CAR SHOPS ABOVE STROUDSBURG.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on August 3, 1911, on the railroad bridge of the Wilkes-Barre and Eastern Railroad near the car shops above Stroudsburg, and is being maintained by Meikleham & Dinsmore, Engineers, New York City. A chain gage is fastened on the second panel of the left downstream side of the bridge. The length of chain from center of rivet to bottom of weight is 23.04 feet, the elevation of zero being arbitrary datum. B. M. No. 1 is cut on top of extreme upstream stone in the upstream wingwall of the right abutment, on top of the 4th stone down from the bridge seat, and is on the extreme upper outer corner; elevation 13.56 feet above gage datum.

Discharge measurements are made from the downstream side of bridge, and by wading below the bridge at low stages. The channel at the bridge is straight, with stone and mud bottom, and with high banks on either side which do not overflow. The channel passes under the bridge at a slight angle. This gage is read twice daily by Robert H. Ace.

Since the establishment of this station, five discharge measurements have been made. Owing to the insufficient number of discharge measurements, no rating curve has been computed at this station, and only the discharge measurements and daily gage heights are published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS McMICHAELS CREEK, AT CAR SHOPS, STROUDSBURG, MONROE COUNTY, PENNA.

(Drainage area 60 square miles.)

No	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft	Ft. per sec.	Feet.	Sec. ft.	
	1912							
5	June 26,	Langenheim, ...	74	62	0.89	3.15	55	Intergration msmt.

DAILY MEAN GAGE HEIGHTS OF McMICHAELS CREEK, AT CAR SHOPS, STROUDSBURG, MONROE CO., PA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	3.68	3.35	3.85	....	3.85	3.38	3.06	3.01	3.00	3.39	3.58	3.48
2,	3.65	3.31	3.87	....	3.78	3.33	3.03	3.00	3.11	3.34	3.64	3.63
3,	3.56	3.27	3.84	*4.33	3.67	3.44	2.99	3.03	3.08	3.33	3.56	3.92
4,	3.55	3.20	3.74	4.14	3.66	3.39	2.98	3.00	3.04	3.30	3.52	3.84
5,	3.56	3.13	3.58	4.09	3.69	3.35	3.00	3.00	3.00	3.29	3.46	3.74
6,	3.61	3.15	3.84	4.00	3.76	3.40	3.08	2.98	3.16	3.26	3.40	4.08
7,	3.54	3.21	3.55	3.98	3.74	5.36	3.08	2.97	3.08	3.25	3.56	3.99
8,	3.46	3.21	3.51	4.05	4.56	3.30	3.02	2.97	3.06	3.24	4.08	3.84
9,	3.48	3.24	3.65	3.92	4.24	3.27	3.00	3.01	3.05	3.22	3.75	3.81
10,	3.48	3.30	3.55	3.80	4.00	3.24	3.01	3.05	3.04	3.20	3.78	3.68
11,	3.51	3.31	3.48	3.74	3.89	3.23	3.00	3.88	3.03	3.41	3.69	3.63
12,	2.54	3.32	3.48	3.70	3.85	3.21	3.01	3.42	3.02	3.36	3.63	3.59
13,	3.56	3.32	b6.56	3.68	3.80	3.20	3.00	3.18	3.00	3.31	3.59	3.55
14,	3.56	3.32	4.26	3.64	3.74	3.17	3.19	3.12	2.99	3.26	3.69	3.52
15,	3.55	3.32	5.58	3.62	3.71	3.15	3.21	3.05	2.98	3.18	3.64	3.48
16,	3.55	3.32	5.48	3.63	4.15	3.24	3.06	3.02	3.96	3.15	3.59	3.44
17,	3.54	3.32	5.06	3.60	4.40	3.20	3.46	3.01	3.23	3.14	3.54	3.41
18,	3.59	3.27	4.61	c4.74	4.16	3.20	3.17	3.02	3.20	3.12	3.49	4.01
19,	3.79	3.25	4.45	4.41	4.04	3.16	3.08	3.26	3.19	3.11	3.44	3.84
20,	3.65	3.30	4.44	4.23	3.92	3.11	3.02	d3.82	3.24	3.08	3.39	3.74
21,	3.57	3.36	4.36	4.15	3.80	3.08	3.03	3.26	3.16	3.08	3.37	3.66
22,	3.51	a5.58	4.18	4.04	3.74	3.10	3.02	3.18	3.17	3.06	3.61	3.62
23,	3.47	3.80	4.07	3.98	3.71	3.11	3.00	3.14	3.18	3.59	3.58	3.59
24,	3.46	3.80	3.29	3.86	3.67	3.12	3.00	3.13	3.44	3.94	3.93	3.54
25,	3.44	3.88	3.32	3.82	3.63	3.12	3.00	3.09	4.39	3.67	3.71	3.50
26,	3.41	3.93	3.28	3.76	3.59	3.19	3.00	3.07	4.02	3.62	3.64	3.55
27,	3.44	4.74	3.17	3.82	3.56	3.16	3.00	3.05	3.88	3.58	3.61	3.65
28,	3.44	4.30	*3.46	3.67	3.46	3.10	3.00	3.04	3.74	3.54	3.54	3.61
29,	3.46	3.85	....	3.80	3.46	3.08	3.00	3.04	3.65	3.51	3.51	3.57
30,	3.43	....	....	3.94	3.49	3.08	3.00	3.02	3.59	3.46	3.48	3.96
31,	3.37	....	....	....	3.42	....	3.00	2.99	....	3.41	....	4.24

*Chain stolen on March 28th and replaced on April 3rd. aMax. 5.85 at 8:00 A. M. b Max. 7.88 at 8:00 A. M. c Max. 5.05 at 8:00 A. M. d Max 4.28 at 8:00 A. M..

LEHIGH RIVER.

DESCRIPTION OF BASIN.

The Lehigh river, the second largest tributary of the Delaware river from Pennsylvania, drains approximately 1,375 square miles, in the central-eastern portion of the State. Rising in the Pocono plateau in the southwest corner of Wayne county, it follows a winding course, generally southeasterly to its mouth at Easton, its length being approximately 100 miles, while the air line distance from its source to its mouth is only 45 miles.

The sources of the upper tributaries lie among the Pocono hills, which are sparsely inhabited, and largely forested. The slope of the river is steep, with numerous rapids, water falls, and glacial lakes. The stream falls about 10 feet per mile until within 15 or 20 miles of the mouth, where it enters the rolling farm lands of Lehigh and Northampton counties, where its slope reduces to 4 or 5 feet per mile. In this portion of the valley is much cultivated land and numerous large cities and boroughs, among the most important being Allentown, South Bethlehem, Bethlehem and Easton.

Numerous of its lower tributaries, among them the Little Lehigh, Jordan, Monocacy and Saucon creeks, drain limestone areas, thus augmenting the dry weather flow. From the west, where the Lehigh passes the anthracite coal fields, the tributaries bring in quantities of culm and mine water.

The chief tributaries are Tobyhanna, Bear, Black, Mahoning, Big, Lizard, Aquachicola, Jordan, Little Lehigh, Monocacy and Saucon creeks.

The banks, especially in the upper portion, are high and rocky, and below Mauch Chunk and White Haven the valley assumes the nature of a gorge. The bed is rock throughout most of its length, in places overlain by a thin layer of drift, and in its lower section, behind the navigation dams, extensive silting has taken place.

The Lehigh Coal and Navigation Company operates a canal and slackwater system of navigation on the lower 45 miles, consisting of 10 dams and locks, and several short sections of canal connecting the pools. Considerable water power is developed along this canal.

Numerous towns and industries in the lower section, in which portion of the valley population and industries are quite congested, use the river water for domestic and industrial purposes, but its impure condition and high sediment content, make purification a requisite.

The basin, which is long and narrow, is subject to an annual average precipitation of 45 to 50 inches.

The flow has been measured from September 22, 1902, to February 13, 1905, and from April 26, 1909, to date, at South Bethlehem, 12 miles above the mouth.

DELAWARE BASIN—STATION NO. 12.

LEHIGH RIVER AT SOUTH BETHLEHEM.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey, September 22nd, 1902, on the New street bridge, connecting Bethlehem and South Bethlehem, and was operated until February 13th, 1905, by Lehigh University. On that date it was discontinued, and was re-established by the Water Supply Commission of Pennsylvania, at the same point, on April 26th, 1909. The present equipment consists of a standard chain and weight gage, similar to that previously employed, the new datum being 0.09 feet higher than the old. The elevation of the zero of the present gage is 210.64 feet above mean tide, referred to the following bench marks: Bench mark No. 2 is No. 72 of L. V. R. R., on iron pin set in south pier of New street bridge at elevation 232.87 feet above sea level, or 22.23 feet above zero of gage. B. M. No. 3 is cross cut in stone on 4th pier from north side, 15th course down from top of pier, downstream face, 2 feet in from left or north downstream corner; elevation 228.06 feet above sea level, or 17.42 feet above zero of gage. The length of chain is 42.89 feet to low water marker and 32.89 feet to high water marker.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being a point on hand-rail over center of pier, between third and fourth trusses from left bank. The channel is straight both above and below the station and the bed is of sand and gravel. The right bank is high and does not overflow, while the left is low and subject to overflow at high stages. The Lehigh canal follows the left bank and passes over Monocacy creek, and under left span of bridge. Monocacy creek passes under canal on left bank, and under bridge, entering the river a short distance below. Canal is measured at Main street bridge, one-third of a mile above, the discharge reduced by tail race flow of ice plant and grist mill, which use canal water between the two bridges, is added to river discharge as measured at New street bridge. There is a spillway from the canal into the creek at the aqueduct, so that the canal cannot be measured at New street bridge. The gage is read twice daily by J. E. Santee, the toll collector at the bridge.

Since the establishment of this station 42 discharge measurements have been made, by the United States Geological Survey, Lehigh University and the Water Supply Commission of Pennsylvania. No discharge measurements were made during 1912.

The rating tables below have been compiled by the United States Geological Survey, as well as all the data from 1902 to 1905 inclusive. Three rating tables have been computed, made necessary by certain changes in the river channel. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE TABLE FOR LEHIGH RIVER, AT SOUTH BETHLEHEM, NORTHAMPTON COUNTY, FROM JAN. 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.00	....	.20	2100	.40	6630	.80	12940	10.00	19490
.10	....	.30	2260	.50	6880	.90	13220	.10	19810
.20	....	.40	2420	.60	7130	8.00	13500	.20	20130
.30	....	.50	2580	.70	7380	.10	13790	.30	20450
.40	....	.60	2750	.80	7630	.20	14080	.40	20770
.50	255	.70	2920	.90	7880	.30	14370	.50	21090
.60	325	.80	3100	6.00	8130	.40	14660	.60	21410
.70	400	.90	3280	.10	8380	.50	14950	.70	21740
.80	480	4.00	3470	.20	8640	.60	15240	.80	22070
.90	565	.10	3670	.30	8900	.70	15530	.90	22400
2.00	655	.20	3870	.40	9160	.80	15820	11.00	22730
.10	750	.30	4070	.50	9420	.90	16120	.10	23070
.20	850	.40	4280	.60	9680	9.00	16420	.20	23410
.30	950	.50	4500	.70	9940	.10	16720	.30	23750
.40	1060	.60	4720	.80	10200	.20	17020	.40	24090
.50	1170	.70	4940	.90	10470	.30	17320	.50	24430
.60	1280	.80	5170	7.00	10740	.40	17630	.60	24770
.70	1400	.90	5400	.10	11010	.50	17940	.70	25110
.80	1530	5.00	5640	.20	11280	.60	18250	.80	25450
.90	1670	.10	5880	.30	11550	.70	18560	.90	25790
3.00	1810	.20	6130	.40	11820	.80	18870	12.00	26130
.10	1950	.30	6380	.50	12100	.90	19180		
				.60	12380				
				.70	12660				

Note—This table is only applicable subsequent to Jan. 1, 1912, and is based on 5 discharge measurements made during 1911 and 1913, together with the 1902 to 1905 curve.

DAILY MEAN HEIGHTS AND DISCHARGES OF LEHIGH RIVER, AT SOUTH BETHLEHEM, NORTHAMPTON CO. PA.

DAY.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
1912	G H	Dis	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	3.43	2470	2.26	910	3.41	2440	5.47	6800	4.28	4080	2.63	1360	1.95	655	1.68	430	1.64	400	2.90	1720	3.08	1970	2.74	1500
2,	3.38	2390	2.28	930	3.17	2060	5.43	6700	4.02	3560	2.53	1240	1.87	584	1.70	445	2.04	738	2.78	1550	3.27	2260	3.15	2070
3,	3.20	2100	2.09	740	2.86	1610	5.77	7560	3.83	3200	2.81	1590	1.83	550	1.64	400	2.16	855	2.64	1370	3.06	1940	4.13	3730
4,	3.09	1940	1.98	687	2.93	1710	5.11	5900	3.63	2850	2.63	1360	1.67	422	1.60	370	2.01	710	2.57	1290	3.01	1870	4.18	3830
5,	2.92	1700	2.53	1200	2.85	1600	4.79	5150	3.53	2680	2.52	1240	1.93	637	1.72	461	1.88	593	2.44	1150	2.90	1720	3.92	3320
6,	2.86	1610	2.54	1210	2.69	1390	4.53	4570	3.54	2690	2.58	1300	1.97	673	1.69	438	1.98	682	2.30	995	2.85	1640	3.94	3360
7,	3.16	2040	2.34	994	2.77	1490	4.40	4280	3.83	3200	2.91	1730	1.95	655	1.59	363	2.37	1070	2.34	1040	3.02	1880	4.05	3570
8,	3.22	2130	2.11	760	3.19	2080	4.78	5010	4.65	4880	2.61	1340	1.97	673	1.57	349	2.40	1100	2.32	1020	4.79	5190	3.80	3100
9,	3.14	2010	2.03	684	3.16	2040	4.31	4090	4.47	4480	2.47	1180	1.75	485	1.66	415	2.07	766	2.22	915	4.34	4200	3.66	2850
10,	3.16	2040	2.20	850	2.85	1600	4.12	3710	4.23	3980	2.46	1170	1.84	559	1.70	445	1.71	453	2.22	915	3.90	3320	3.47	2580
11,	2.98	1780	2.36	1020	2.86	1610	3.93	3340	4.08	3580	2.35	1050	2.06	757	2.92	1740	1.70	445	2.67	1410	3.77	3090	3.40	2420
12,	2.88	1640	2.23	880	3.54	2650	3.80	3100	3.92	3360	2.27	965	1.97	673	2.40	1100	1.77	501	2.55	1270	3.53	2680	3.25	2180
13,	2.82	1560	2.06	712	8.37	14600	3.80	3100	3.81	3160	2.25	945	1.90	610	2.24	935	1.64	400	2.28	975	3.39	2450	2.78	1500
14,	2.62	1300	2.05	702	4.94	5500	3.72	2960	3.63	2850	2.22	915	1.76	493	2.19	885	1.68	430	2.38	1080	3.40	2460	2.91	1680
15,	2.72	1430	2.05	702	b9.06	16600	3.69	2900	3.53	2680	2.17	865	1.97	673	2.23	925	1.56	342	2.27	965	3.29	2290	2.91	1680
16,	2.91	1680	2.07	722	8.73	15600	3.68	2890	3.74	3040	2.23	925	1.86	576	2.17	865	2.42	1130	2.19	885	3.12	2020	3.00	1810
17,	2.95	1740	2.06	712	6.28	8800	3.90	3280	4.49	4520	2.34	1040	1.88	593	1.89	602	2.22	915	2.17	865	2.92	1740	2.98	1710
18,	2.71	1410	2.12	770	5.60	7130	5.09	5860	4.08	3580	2.34	1040	2.04	738	1.71	453	2.10	795	2.12	815	2.92	1740	2.93	1700
19,	2.85	1600	2.42	1080	5.36	6530	5.97	8060	3.78	3110	2.23	925	1.91	619	2.10	795	2.11	805	2.08	776	2.87	1670	3.13	2000
20,	2.96	1750	2.75	1460	5.21	6160	5.28	6330	3.61	2810	2.12	815	1.83	550	2.70	1440	2.22	915	1.94	646	2.83	1610	3.60	2750
21,	2.89	1660	a4.30	4070	4.86	5310	4.65	4830	3.38	2430	2.09	786	1.74	477	2.41	1120	2.01	710	2.07	766	2.75	1510	3.23	2150
22,	2.86	1610	6.95	10600	4.46	4410	4.50	4500	3.18	2120	2.06	757	2.07	766	2.23	925	1.86	576	2.10	795	2.72	1470	2.99	1800
23,	2.64	1330	3.67	2870	4.44	4370	4.35	4180	3.14	2060	2.02	719	1.90	610	2.26	955	2.03	728	2.76	1520	2.69	1430	3.01	1820
24,	2.57	1250	3.40	2420	4.59	4700	4.05	3570	3.06	1970	2.05	748	1.84	559	2.09	786	2.45	1160	4.55	4660	3.09	1980	2.94	1730
25,	2.51	1180	3.41	2440	5.06	5760	3.89	3260	2.99	1840	2.06	757	1.78	509	1.95	655	5.14	6020	5.04	5780	3.56	2730	2.77	1490
26,	2.46	1130	3.81	3120	4.71	4960	3.73	3020	2.88	1690	2.06	757	1.74	477	2.01	710	4.99	5660	4.39	4300	3.17	2100	2.91	1680
27,	2.38	1040	5.11	5900	4.54	4590	3.65	2880	2.80	1580	2.02	719	1.63	392	1.80	525	4.16	3840	3.99	3500	3.02	1880	2.95	1740
28,	2.21	860	4.09	3650	4.64	4810	3.69	2950	2.69	1430	1.97	673	1.68	430	1.82	542	3.47	2580	3.73	3020	2.92	1740	3.32	2290
29,	2.29	940	3.70	2920	5.38	6580	3.55	2710	2.84	1630	1.95	655	1.84	559	1.83	550	3.19	2130	3.47	2580	2.90	1720	2.95	1740
30,	2.38	1040	......	......	7.08	10800	4.36	4240	2.87	1670	1.87	584	1.70	445	1.82	542	3.14	2060	3.30	2300	2.79	1560	3.12	1980
31,	2.32	972	......	......	5.85	7760	....	......	2.85	1640	....	......	1.53	321	1.75	485	....	......	3.15	2070	....	......	4.69	4920

a Max. 8.25 at 7:30 A. M.; 14200 sec. ft. b Max. 10.75 at 6 P. M.; 21900 sec. ft. Canal in operation April 26 to December 2, 1912, during which period 45 sec. ft. were added to the discharge.

ESTIMATED MONTHLY DISCHARGE OF LEHIGH RIVER, AT SOUTH BETHLEHEM, NORTHAMPTON COUNTY, PA.

(Drainage area 1,235 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	2470	860	1590	1.287	1.484
February,	14200	687	1920	1.555	1.677
March,	21900	1890	5400	4.372	5.040
April,	8060	2710	4390	3.555	3.966
May,	4880	1430	2850	2.308	2.661
June,	1720	584	1000	0.810	0.904
July,	766	321	572	0.463	0.534
August,	1740	349	698	0.565	0.651
September,	6020	312	1320	1.069	1.193
October,	5780	646	1710	1.385	1.597
November,	5190	1430	2200	1.781	1.987
December,	4920	1500	2340	1.895	2.184
The year,	21900	321	2170	1.754	23.878

DELAWARE BASIN—STATION NO. 13.

DELAWARE RIVER AT RIEGELSVILLE, N. J.

This station was established by the United States Geological Survey, July 3, 1906, on the three span, steel suspension, toll highway bridge, at Riegelsville, N. J. A chain gage is attached to the upstream handrail in the middle span 20 feet from the east pier. The length of chain from center of rivet to bottom of weight is 43.49 feet, the elevation of zero being arbitrary datum. A B. M. is located on top of steel part of downstream cable anchorage on New Jersey side, which is 40.76 feet above zero of the gage. Discharge measurements are made from the downstream side of the bridge, and the initial point is the face of the left abutment. The channel of the river is straight both above and below the station, the left bank being high and never overflowing, while the right bank, although high, is subject to overflow during extreme high waters. The bed of the stream is gravel and boulders, and fairly permanent, with from 12 to 15 feet depth of water during ordinary stages. This gage is read twice daily by John H. Deemer, the toll collector at the bridge.

The Delaware Division Canal parallels the river along the Pennsylvania shore about 200 feet from the river, and is measured at a highway bridge, a short distance above the river bridge.

Since the establishment of this gage 17 discharge measurements have been made. The following data have been furnished by the U. S. Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF DELAWARE RIVER, AT RIEGELSVILLE, N. J.

(Drainage area 6,430 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
17	1913. Feb. 20,	Reckord & Batley, .	469	4157	1.40	3.78	5819	0.6 measurement.

DISCHARGE TABLE FOR DELAWARE RIVER, AT RIEGELSVILLE, N. J., FROM 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.50	810	.80	8820	.10	22060	.30	39980	.50	61690
.60	930	.90	9160	.20	22560	.40	40560	.60	62410
.70	1060	5.00	9500	.30	23050	.50	41190	.70	63130
.80	1200	.10	9840	.40	23540	.60	41820	.80	63850
.90	1350	.20	10190	.50	24040	.70	42460	.90	64570.
2.00	1500	.30	10540	.60	24540	.80	43100	15.00	65300
.10	1660	.40	10890	.70	25050	.90	43750	.10	66030
.20	1830	.50	11250	.80	25560	12.00	44400	.20	66760
.30	2010	.60	11610	.90	26080	.10	45060	.30	67490
.40	2200	.70	11980	9.00	26600	.20	45720	.40	68220
.50	2400	.80	12350	.10	27130	.30	46380	.50	68950
.60	2600	.90	12720	.20	27660	.40	47050	.60	69680
.70	2810	6.00	13100	.30	28200	.50	47720	.70	70410
.80	3030	.10	13480	.40	28750	.60	48390	.80	71140
.90	3260	.20	13860	.50	29300.	.70	49060	.90	71870
3.00	3500	.30	14250	.60	29860	.80	49740	16.00	72600
.10	3750	.40	14640	.70	30420	.90	50420	.10	73340
.20	4000	.50	15040	.80	30990	13.00	51100	.20	74080
.30	4260	.60	15440	.90	31560	.10	51790.	.30	74820
.40	4530	.70	15850	10.00	32130	.20	52480	.40	75560
.50	4800	.80	16260	.10	32710	.30	53170	.50	76300.
.60	5080	.90	16680	.20	33290	.40	53870	.60	77050
.70	5360	7.00	17100	.30	33880	.50	54570	.70	77800
.80	5650	.10	17530	.40	34470	.60	55270	.80	78550
.90	5950	.20	17960	.50	35060	.70	55970	.90	79300
4.00	6250	.30	18400	.60	35660	.80	56680	17.00	80050
.10	6560	.40	18840	.70	36260	.90	57390	18.00	87650
.20	6870	.50	19290	.80	36860	14.00	58100	19.00	95350
.30	7190	.60	19740	.90	37470	.10	58810	20.00	103150
.40	7510	.70	20200	11.00	38080	.20	59530		
.50	7830	.80	20660	.10	38690	.30	60250		
.60	8160	.90	21130	.20	39310	.40	60970		
.70	8490	8.00	21600						

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF DELAWARE RIVER, AT RIEGELSVILLE, N. J.

DAY.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
1912	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	5.7	12000	3.4	4530	6.1	13500	11.6	41800	9.5	29300	4.5	7830	2.5	2400	2.2	1830	2.65	2700	4.1	6560	4.9	9160	4.1	6560
2, ...	5.4	10900	3.5	4800	5.4	10900	11.9	43800	8.4	23500	4.2	6870	2.5	2400	2.15	1740	2.85	3140	4.0	6250	5.3	10600	4.1	6560
3, ...	5.4	10900	3.3	4260	4.9	9160	13.1	51800	7.7	20200	4.3	7190	2.4	2200	2.2	1830	3.2	4000	3.7	5360	5.0	9500	5.3	10600
4, ...	5.4	10900	3.3	4260	4.6	8160	14.2	59100	7.1	17500	4.4	7510	2.4	2200	2.15	1740	3.8	5650	3.6	5080	4.9	9160	7.6	19700
5, ...	4.7	8490	3.2	4000	4.5	7830	11.2	39300	6.4	14600	4.2	6870	2.35	2100	2.2	1830	3.7	5360	3.5	4800	4.6	8160	7.6	19700
6, ...	3.8	5650	3.1	3750	4.1	6560	9.8	31000	6.3	14200	4.2	6870	2.4	2200	2.15	1740	3.4	4530	3.3	4260	4.4	7510	7.0	17100
7, ...	3.8	5650	3.2	4000	4.2	6870	9.2	27700	6.4	14600	4.4	7510	2.4	2200	2.05	1580	3.3	4260	3.2	4000	4.3	7190	7.7	20200
8, ...	3.8	5650	3.2	4000	4.4	7510	9.9	31600	7.4	18800	4.3	7190	2.4	2200	2.05	1580	3.5	4800	3.1	3750	6.1	13500	7.8	20700
9, ...	3.7	5360	3.1	3750	4.5	7830	11.0	38100	7.8	20700	4.1	6560	2.4	2200	2.05	1580	3.3	4260	3.0	3500	7.3	18400	7.0	17100
10, ...	3.7	5360	2.85	3140	4.4	7510	9.5	29300	7.9	21100	3.9	5950	2.3	2010	2.15	1740	3.1	3750	2.95	3380	7.4	18800	6.3	14200
11, ...	3.8	5650	3.0	3500	4.9	9160	8.5	24000	7.3	18400	3.7	5360	2.35	2100	3.8	5650	2.9	3260	3.2	4000	7.6	19700	5.8	12400
12, ...	4.2	6870	2.9	3260	5.0	9500	7.9	21100	6.9	16700	3.5	4800	2.55	2500	4.8	8820	2.75	2920	3.3	4260	6.1	13500	5.6	11600
13, ...	4.0	6250	2.9	3260	12.2	45700	7.5	19300	6.4	14600	3.4	4530	2.45	2300	3.9	5950	2.75	2920	3.0	3500	5.6	11600	5.0	9500
14, ...	3.8	5650	2.9	3260	10.1	32700	7.4	18800	6.1	13500	3.3	4260	2.4	2200	3.7	5360	2.6	2600	3.1	3750	5.5	11200	4.7	8490
15, ...	4.0	6250	2.95	3380	12.2	45700	7.2	18000	6.0	13100	3.3	4260	2.6	2600	3.2	4000	2.55	2500	3.0	3500	5.3	10600	4.4	7510
16, ...	3.8	5650	2.95	3380	17.4	83000	7.1	17500	5.9	12700	3.3	4260	2.6	2600	3.1	3750	3.1	3750	2.9	3260	5.1	9840	4.6	8160
17, ...	3.9	5950	3.0	3500	16.9	79300	9.8	31000	7.5	19300	3.4	4530	2.5	2400	2.85	3140	3.2	4000	2.8	3030	4.8	8820	4.7	8490
18, ...	4.0	6250	3.0	3500	12.8	49700	10.8	36900	7.9	21100	3.3	4260	2.7	2810	2.75	2920	2.9	3260	2.75	2920	4.6	8160	4.5	7830
19, ...	4.2	6870	3.2	4000	11.9	43800	12.3	46400	7.3	18400	3.2	4000	2.6	2600	3.0	3500	2.95	3380	2.7	2810	4.4	7510	4.8	8820
20, ...	4.5	7830	3.4	4530	11.5	44200	12.0	44100	6.8	16300	3.2	4000	2.75	2920	3.6	5080	3.0	3500	2.65	2700	4.3	7190	5.7	12000
21, ...	4.4	7510	4.0	6250	11.2	39800	10.6	35700	6.4	14600	3.1	3750	2.95	3380	3.5	4800	3.0	3500	2.7	2810	4.2	6870	6.5	15000
22, ...	4.3	7190	8.7	25000	9.8	31000	9.3	28200	5.9	12700	2.9	3260	2.95	3380	3.3	4260	2.95	3380	2.7	2810	4.1	6560	5.7	12000
23, ...	4.4	7510	5.3	10600	8.7	25000	8.6	24500	5.6	11600	2.85	3140	2.7	2810	3.3	4260	2.85	3140	3.4	4530	4.0	6250	5.3	10600
24, ...	4.5	7830	5.2	10200	8.7	25000	8.2	22600	5.4	10900	2.9	3260	2.65	2700	3.3	4260	2.85	3140	6.1	13500	4.1	6560	5.1	9840
25, ...	4.2	6870	5.7	12000	9.0	26600	7.7	20200	5.2	10200	2.85	3140	2.6	2600	3.4	4530	5.2	10200	9.7	30400	4.9	9160	4.6	8160
26, ...	3.9	5950	5.9	12700	8.4	23500	7.3	18400	5.0	9500	2.85	3140	2.4	2200	3.6	5080	6.4	14600	9.5	29800	4.8	8820	4.4	7510
27, ...	3.8	5650	8.1	22100	7.7	20200	6.9	16700	4.8	8820	2.85	3140	2.3	2010	3.3	4260	6.2	13900	8.0	21600	4.8	8820	4.8	8820
28, ...	3.6	5080	6.8	16300	7.8	20700	6.8	16300	4.5	7830	2.75	2920	2.25	1920	3.2	4000	5.6	11600	6.9	16700	4.6	8160	5.5	11200
29, ...	3.6	5080	6.3	14200	9.2	27700	6.4	14600	4.4	7510	2.65	2700	2.2	1830	3.1	3750	4.8	8820	6.3	14200	4.4	7510	5.0	9500
30, ...	3.6	5080	....	......	15.4	65200	7.9	21100	4.6	8160	....	2550	2.2	1830	2.85	3140	4.5	7830	5.7	12000	4.2	6870	5.2	10200
31, ...	3.6	5080	....	......	14.0	58100	....	......	4.6	8160	....	.....	2.2	1830	2.75	2920	....	......	5.2	10200	....	......	7.1	17500

No corrections made for ice conditions. March 25 to December 8, 270 sec. ft. added (for canal) before computing run off values.

ESTIMATED MONTHLY DISCHARGE OF DELAWARE RIVER, AT RIEGELSVILLE, N. J.

(Drainage area 6,430 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	12000	5080	6870	1.07	1.23
February,	25000	3140	7060	1.10	1.19
March,	83000	6560	28800	4.49	5.18
April,	59500	14600	29700	4.65	5.19
May,	29300	7510	15100	2.40	2.77
June,	7830	2550	4850	0.796	0.89
July,	8350	1830	2380	0.412	0.48
August,	8820	1580	3570	0.597	0.69
September,	14600	2500	5160	0.843	0.94
October,	30400	2700	7700	1.24	1.43
Novmeber,	19700	6250	9850	1.57	1.75
December,	20700	6560	11800	1.85	2.13
The year,	83000	1580	11100	1.76	23.87

DELAWARE BASIN—STATION NO. 14.

TOHICKON CREEK AT POINT PLEASANT, PA.

Tohickon creek rises in the western part of Bucks county, Pa., and flows eastward into the Delaware at Point Pleasant. Its drainage area comprises about 102 square miles, the greater part being farm land under a high degree of cultivation, the original forest cover having been almost entirely cut away. The stream is subject to very sudden freshets, and during heavy rains large quantities of surface soil are eroded. The fall of the stream from its source to the gaging station is about 600 feet in 28 miles. The average yearly rainfall over this watershed is from 45 to 50 inches.

The gaging station is located about one-eighth mile above the mouth of the creek, and the records show the discharge of practically the entire drainage area. Continuous records of flow have been obtained each year since 1883, with the exception of 1900, by the Philadelphia Bureau of Water, Department of Public Works, under the personal supervision of John E. Codman.

An automatic gage is used to obtain a continuous record of gage height. The lower part of the rating curve has been developed from the computed discharge over a weir, and the discharge at high stages is determined from a curve developed from current-meter measurements. The rating curve is well defined.

The following data have been furnished by the Philadelphia Bureau of Water. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DAILY DISCHARGE OF TOHICKON CREEK, AT POINT PLEASANT, BUCKS COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.
1,	99	59	162	200	341	15	9	33	5	35	374	48
2,	93	53	113	151	156	10	7	12	7	33	369	98
3,	74	51	83	286	95	12	6	11	7	27	381	510
4,	53	49	70	166	71	14	6	6	11	20	91	226
5,	58	46	51	102	59	12	6	10	12	20	59	124
6,	58	44	58	81	63	11	5	13	11	19	51	206
7,	58	44	57	83	79	16	4	9	11	15	1266	290
8,	58	44	57	110	602	16	4	5	8	16	1489	142
9,	58	42	104	103	492	17	4	5	24	15	354	83
10,	53	39	148	70	214	17	3	410	34	13	160	59
11,	49	35	130	58	118	17	3	316	25	12	114	56
12,	49	31	632	50	77	16	3	57	18	12	89	50
13,	49	31	3298	48	69	11	3	27	17	8	76	49
14,	53	27	545	48	68	7	6	26	15	7	102	49
15,	58	23	3800	52	59	8	10	26	6	10	122	46
16,	56	23	2459	63	60	8	8	21	11	9	98	46
17,	50	20	620	279	503	8	5	14	11	9	65	44
18,	47	202	323	614	162	9	6	8	6	9	54	40
19,	453	671	296	816	70	8	6	7	8	8	52	438
20,	822	1297	940	318	46	7	6	16	17	6	46	373
21,	638	1670	482	136	33	7	6	23	15	8	42	183
22,	547	1843	218	102	24	8	12	19	6	12	44	84
23,	491	599	244	112	22	6	12	18	8	1786	43	75
24,	462	260	2182	100	31	6	6	18	98	2465	788	67
25,	460	302	1470	70	29	6	10	13	2123	1055	662	71
26,	407	545	480	60	18	8	7	7	794	298	205	81
27,	304	1716	239	57	18	8	7	8	196	139	120	268
28,	163	768	192	108	16	6	6	6	83	87	80	432
29,	69	262	1532	121	15	20	5	5	39	63	60	851
30,	65	....	644	628	15	16	5	6	40	51	50	2308
31,	64	....	306	....	21	....	8	6	....	43	....	2761

ESTIMATED MONTHLY DISCHARGE OF TOHICKON CREEK, AT POINT PLEASANT, BUCKS COUNTY, PA.

(Drainage area 102 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	822	47	196	1.922	2.216
February,	1843	20	372	3.647	3.934
March,	3800	51	706	6.922	7.980
April,	816	48	173	1.696	1.893
May,	602	15	118	1.157	1.334
June,	20	6	11	.108	.121
July,	12	3	6	.059	.068
August,	410	5	37	.363	.419
September,	2123	5	122	1.196	1.335
October,	2465	6	204	2.000	2.306
November,	1489	42	250	2.451	2.734
December,	2761	40	310	3.039	3.504
The year,	3800	3	209	2.047	27.844

DELAWARE BASIN—STATION NO. 15.

NESHAMINY CREEK BELOW THE FORKS, NEAR RUSHLAND, PA.

Neshaminy creek rises in the eastern part of Montgomery county, Pa., flows in a southeasterly and southerly course, and enters Delaware river at a point about 12 miles above Philadelphia. The drainage area, measured at the forks of the Big and Little Neshaminy, is 139 square miles, mostly farm land in a high state of cultivation, the original forest growth having been almost entirely cut away. The stream is subject to very sudden freshets, and during heavy rains large quantities of surface soil are eroded. The fall of the stream from its source to the gaging station is about 600 feet in 27 miles. The average yearly rainfall over this watershed is from 40 to 50 inches.

The gaging station is located a short distance below the junction of Big and Little Neshaminy creeks, and the discharge represents about one-half of the total drainage area of the stream. Continuous records of discharge have been obtained since 1884 by the Philadelphia Bureau of Water, Department of Public Works, under the personal supervision of John E. Codman, by whom the records have been furnished.

An automatic gage is used to obtain a continuous record of gage height. The lower part of the rating curve has been developed from the computed discharge over a weir, and the discharge at high stages is determined from a curve developed from current meter measurements. The rating curve is well defined.

The following data have been furnished by the Philadelphia Bureau of Water. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DAILY DISCHARGE OF NESHAMINY CREEK BELOW THE FORKS, BUCKS COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.
1,	300	148	98	286	256	42	13	16	15	41	144	94
2,	210	122	92	500	159	38	13	14	23	34	294	128
3,	159	111	104	778	130	36	13	12	88	30	154	249
4,	140	109	234	282	112	33	12	12	36	28	84	158
5,	125	109	221	214	100	32	12	11	24	28	84	125
6,	125	111	80	190	106	51	12	10	22	25	88	257
7,	105	122	76	188	110	61	12	11	20	20	1696	273
8,	166	136	108	194	416	42	12	11	32	18	1808	139
9,	105	134	106	170	392	30	11	10	60	16	278	114
10,	105	130	164	139	246	28	11	10	25	18	197	94
11,	105	133	112	125	172	24	13	1258	18	19	165	92
12,	96	126	118	114	148	24	14	146	14	21	140	100
13,	106	120	4073	109	128	22	12	74	12	20	127	115
14,	134	134	399	111	104	21	33	36	12	18	200	112
15,	144	149	4000	108	104	21	42	30	12	17	204	99
16,	144	174	1458	101	178	22	24	28	12	16	122	77
17,	144	269	444	154	218	30	16	21	12	14	107	68
18,	157	492	372	449	145	30	21	38	12	12	99	67
19,	485	786	346	896	95	21	28	112	14	14	92	756
20,	734	680	1098	502	82	20	24	484	14	16	88	273
21,	521	2584	452	190	70	19	44	92	12	14	81	122
22,	323	2440	340	167	62	19	52	107	12	14	75	121
23,	271	230	411	162	58	18	29	54	12	2948	72	102
24,	275	176	3008	138	56	16	20	36	672	3631	644	165
25,	236	166	1313	114	57	16	18	33	1886	948	370	249
26,	274	895	483	106	55	16	17	25	394	255	188	292
27,	263	2520	339	132	48	17	12	18	159	166	146	1101
28,	242	364	303	158	42	18	12	16	88	128	123	1846
29,	219	211	2056	163	62	17	23	18	62	104	111	762
30,	214	....	751	500	70	15	26	19	49	99	100	1400
31,	188	....	372	....	49	....	17	16	....	89	....	1796

ESTIMATED MONTHLY DISCHARGE OF NESHAMINY CREEK BELOW THE FORKS, BUCKS COUNTY, PA.

(Drainage area 139 square miles.)

MONTH.	Discharge in Second feet.			Run off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	734	96	220	1.583	1.825
February,	2534	109	477	3.432	3.701
March,	4073	76	759	5.460	6.295
April,	896	101	248	1.784	1.990
May,	416	42	130	0.935	1.078
June,	61	15	27	0.194	0.216
July,	52	11	20	0.144	0.166
August,	1253	10	89	0.640	0.738
September,	1386	13	117	0.842	0.939
October,	3631	12	285	2.050	2.363
November,	1696	72	252	1.813	2.023
December,	1796	67	348	2.504	2.887
The year,	4073	10	248	1.782	24.221

DELAWARE BASIN—STATION NO. 16.

PERKIOMEN CREEK, NEAR FREDERICK (SPRING MOUNT), PA.

Perkiomen creek rises in the western part of Bucks county, Pa., flows southward, and discharges into the Schuylkill about 7 miles above Norristown and 18 miles above Philadelphia. Its drainage area comprises about 345 square miles. The area is mostly in farm land under a high state of cultivation, the original forest growth having been almost entirely cut away. The stream is subject to very sudden freshets, and during heavy rains large quantities of surface soil are eroded. The fall of the creek from its source to the gaging station is about 800 feet in 24 miles. The average yearly rainfall over this watershed is from 40 to 50 inches.

Continuous records of discharge have been obtained since 1884 by the Philadelphia Bureau of Water, Department of Public Works, under the personal supervision of John E. Codman, by whom the following records have been furnished. The gaging station is located about 12 miles above the mouth of the creek, above the East Branch, and the discharge represents about one-third of the total area drained by the stream.

An automatic gage is used to obtain a continuous record of gage height. The lower part of the rating curve has been developed from the computed discharge over a weir, and the discharge at high stages is determined from a curve developed from current meter measurements. The rating curve is well defined.

The following data have been furnished by the Philadelphia Bureau of Water. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DAILY DISCHARGE OF PERKIOMEN CREEK, AT FREDERICK, (SPRING MOUNT) MONTGOMERY COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.
1,	222	168	208	334	855	104	52	93	88	116	172	90
2,	196	162	150	298	227	76	44	115	91	98	439	140
3,	173	152	128	530	177	84	48	70	110	92	316	480
4,	167	142	116	276	158	104	44	59	72	86	126	216
5,	171	149	102	216	136	91	40	47	47	78	104	165
6,	168	149	88	197	140	81	34	63	45	77	94	373
7,	188	142	111	190	157	198	37	64	58	73	865	298
8,	203	144	148	282	414	152	35	33	120	64	1066	190
9,	198	147	244	217	422	106	31	23	142	56	498	153
10,	198	147	254	173	263	76	32	46	89	54	236	125
11,	183	147	178	158	186	48	30	666	62	66	171	119
12,	168	152	1226	149	166	36	168	174	52	72	146	118
13,	178	152	4670	135	201	38	81	111	43	61	129	100
14,	188	147	530	138	205	41	130	84	41	52	297	84
15,	188	147	5196	148	160	48	50	367	36	51	222	82
16,	188	158	1979	151	1248	44	44	110	37	40	149	94
17,	188	178	584	216	1054	51	51	65	44	40	123	98
18,	188	254	456	384	381	61	60	55	47	41	123	92
19,	357	461	410	636	264	61	65	320	71	38	115	651
20,	947	691	882	342	212	51	58	134	100	35	96	314
21,	614	1399	508	234	182	48	62	84	80	39	94	218
22,	407	3658	418	204	161	54	151	74	40	45	94	140
23,	266	343	436	234	126	48	100	193	36	1728	93	119
24,	366	468	2123	206	112	39	69	118	1489	1007	556	112
25,	336	347	1362	162	120	42	54	72	3783	622	388	116
26,	305	513	594	152	117	51	52	67	472	300	188	186
27,	292	2825	404	172	93	75	45	114	326	204	152	368
28,	254	572	371	190	80	79	39	64	284	154	124	519
29,	233	278	1990	188	118	63	38	53	161	129	113	358
30.	212	....	9[illegible]5	480	152	58	38	49	132	110	102	3069
31,	181	....	420	....	139	....	38	43	....	96	....	2073

ESTIMATED MONTHLY DISCHARGE OF PERKIOMEN CREEK, AT FREDERICK, (SPRING MOUNT), MONTGOMERY COUNTY.

(Drainage area 152 square miles.)

MONTH.	Discharge in Second-feet.			Run off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	947	167	265	1.743	2.010
February,	3658	142	494	3.250	3.505
March,	4670	88	878	5.776	6.659
April,	636	135	246	1.618	1.805
May,	1248	80	256	1.684	1.941
June,	198	36	70	.461	.514
July,	168	30	59	.388	.448
August,	666	23	117	.770	.888
September,	3783	36	270	1.776	1.982
October,	1728	35	185	1.217	1.403
November,	1066	93	246	1.618	1.806
December,	3069	82	361	2.375	2.738
The year,	4670	23	287	1.890	25.698

DELAWARE BASIN—STATION NO. 17.

SCHUYLKILL RIVER AT PHILADELPHIA, PA.

Schuylkill river rises in the central part of Schuylkill county, Pa., in two branches, which join at Schuylkill Haven, flows southeastward, and unites with the Delaware river at Philadelphia. Its length to the forks is about 113 miles, and its drainage area measures about 1,920 square miles. The headwaters of the river lie in a mountainous, coal-bearing region, but 25 or 30 miles below its source it enters a more highly cultivated country and the slope becomes more gentle. There are few natural lakes in the basin, but numerous reservoirs have been constructed for the benefit of navigation and water supply. The low water flow is augmented by mine drainage. Severe floods have been frequent, the greatest in recent years being that of March, 1902. The Schuylkill is navigable for ocean-going vessels only as far as Fairmount, 8.4 miles from its mouth, where the first dam is built across the river, while above that point it is navigable for river barges as far as Port Clinton, 98 miles above its mouth. The elevation of the river at the forks is 550 feet, and at the mouth 0. A part of the water supply for the City of Philadelphia comes from the Schuylkill, while many other towns and cities use the river and its tributaries. The river receives a large amount of pollution from various sources, including a vast amount of culm from the coal mines. The average yearly rainfall over this watershed varies considerably, ranging between 40 and 55 inches, the upper portion of the watershed receiving the heaviest precipitation in the State.

Records of the height of the river at Fairmount Pool have been kept for many years, but not in such form as to be useful for the computation of daily discharges. Since 1903, however, daily discharges have been computed. The station is located at the Fairmount dam, Philadelphia. The computed daily discharges represent the total flow of the river as determined from the amount wasted over the flashboards at the Fairmount dam, the pumpage from the river, the leakage, and the quantity used for power at Fairmount.

The following data have been furnished by the Philadelphia Bureau of Water. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DAILY DISCHARGE OF SCHUYLKILL RIVER AT FAIRMOUNT DAM, PHILADELPHIA, PA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.
1, ...	3569	1300	1682	6801	3623	1038	396	518	721	1371	1265	996
2, ...	3569	1283	2493	5701	2755	800	312	555	1079	1023	1617	996
3, ...	2160	1033	1923	5511	2336	562	396	555	1032	870	1617	1427
4, ...	2745	929	1549	4853	2336	1026	480	555	2648	796	1265	2077
5, ...	2789	929	1549	4111	2149	1026	459	555	1267	869	1183	1513
6, ...	1623	1083	1390	3774	1785	872	396	480	1130	640	1261	1921
7, ...	963	1033	1236	3341	1978	1415	1100	381	1160	859	3195	2709
8, ...	975	929	1390	3211	2755	1571	956	356	1266	575	2310	2164
9, ...	1114	929	1923	3107	3623	1167	699	356	560	575	3668	1632
10, ...	1530	578	2276	2890	3173	844	586	377	396	331	2627	1813
11, ...	1675	512	2276	2779	2567	784	396	4809	325	331	2622	1231
12, ...	1675	578	2091	2779	2151	559	956	2894	325	827	2258	1356
13, ...	1575	522	29540	2591	2151	415	1183	1888	325	1009	1815	1153
14, ...	1459	522	14273	2374	2091	394	1257	1618	325	751	1992	1007
15, ...	2718	578	15423	2374	2336	394	1257	2176	325	350	1902	950
16, ...	2568	578	35101	2374	2336	394	1257	1409	325	572	1489	1114
17, ...	1143	578	14369	2374	6120	698	468	823	334	308	1336	1114
18, ...	1143	634	7988	3243	5748	668	667	1252	368	327	1182	1114
19, ...	1408	1267	6223	5786	2336	479	699	1252	676	535	1062	2366
20, ...	2423	1721	7085	6361	2336	479	372	1888	442	329	998	3398
21, ...	2945	2053	6223	4686	2336	311	412	1888	442	435	998	2118
22, ...	2365	17480	5123	4111	1972	311	464	1618	400	435	998	1725
23, ...	1910	19310	6283	3981	1609	311	562	1618	394	4253	1024	1491
24, ...	1910	8796	12273	3663	1609	311	750	1888	540	7891	1796	1435
25, ...	2020	3215	9843	3108	1532	311	425	1618	13452	7416	2737	1435
26, ...	1910	2571	8193	2535	1450	311	380	1016	6392	4079	1929	1435
27, ...	1290	9637	6433	2374	1418	311	380	727	3062	2609	1335	2234
28, ...	1190	13620	4863	2374	1289	395	380	727	2010	2103	1113	3404
29, ...	1290	7325	10198	2502	1217	479	312	920	1409	1748	1062	3030
30, ...	1457	....	12188	2779	1143	585	321	920	976	1440	993	10356
31, ...	1290	....	8608	.✓......	1099	....	396	920	....	952	....	19352

ESTIMATED MONTHLY DISCHARGE OF SCHUYLKILL RIVER, AT FAIRMOUNT DAM, PHILA., PA.

(Drainage area 1,920 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	3569	968	1882	0.980	1.130
February,	19310	512	3506	1.826	1.970
March,	35101	1236	7807	4.066	4.688
April,	6801	2374	3617	1.884	2.102
May,	6120	1099	2366	1.232	1.420
June,	1571	311	641	0.334	0.372
July,	1257	312	615	0.320	0.369
August,	4809	356	1244	0.648	0.747
September,	13452	325	1470	0.766	0.855
October,	7891	308	1504	0.783	0.903
November,	9310	998	1933	1.007	1.124
December,	19353	950	2567	1.337	1.541
The year,	35101	308	2429	1.265	17.221

DARBY CREEK.

DESCRIPTION OF BASIN.

Darby creek, a tributary of the Delaware river, at Essington, Philadelphia county, drains approximately 78 square miles in Chester, Philadelphia and Delaware counties. Rising in the northwestern part of Chester county, just south of Malvern station, it follows a general northeasterly direction, through a thickly populated, deforested, rolling agricultural region to the tidal swamps of the Delaware river, just below Darby borough, where it turns southwestward along the western side of the swamp to its mouth, a total length of approximately 24 miles. Its source lies at an elevation of about 475 feet above sea level, and its mouth at sea level. In its upper section the slope of the stream is steep, while in the lower section it is very flat. The principal tributary is Bobbs creek, which enters it six miles above its mouth. A few mills operated by waterpower exist on this stream.

The average yearly rainfall over this watershed is from 45 to 50 inches.

The flow has been measured since July 31st, 1911, at Lansdowne, approximately 8 miles above the mouth, above which point the tributary drainage area is 35 square miles.

DELAWARE BASIN—STATION NO. 18.

DARBY CREEK AT LANSDOWNE.

DESCRIPTION OF STATION.

This station was established July 31, 1911, by the Water Supply Commission of Pennsylvania. A 10 foot staff gage has been fastened to a large tree which projects over the water on the right bank of the stream, about 300 feet upstream from a single span, through truss, highway bridge, near the greenhouse of C. H. Baker. A high water staff gage graduated above 5 feet, is fastened to a large tree a short distance from the 10 foot gage and is referred to the same datum.

Discharge measurements at low and normal stages of the creek are made by wading near the gage and at high water stages from the highway bridge. The initial point for soundings is the right end of upstream handrail on bridge. B. M. No. 1 is on top of spike in groove cut in root of a large white walnut tree on south bank, 15 paces from low water gage and 10 paces from high water gage, and is painted B. M.; elevation 6.695 feet above zero of gage. The creek channel is straight for approximately 50 feet above the gage and 600 feet below it. At wading section the bed is small stones and mud, and at the bridge the bottom is mud and liable to changes in depth. Neither bank at the bridge section overflows at high stages. Slack water from the dam of the Garrett Paper Mill extends to a point about 100 feet above the bridge and 200 feet below the gage, however, there is a fair flow under the bridge, except at extreme low water. This gage is read twice daily by C. H. Baker.

Since the establishment of this station 5 discharge measurements have been made. No rating curve has been determined, and only the discharge measurements and gage heights have been published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF DARBY CREEK, AT LANSDOWNE, DELAWARE COUNTY, PENNA.

(Drainage area 35 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
4	1912 July 2,	Langenheim, ...	23	14	1.00	0.71	13.7	Wading msmt. 100′ below gage.
5	1913. Feb. 19,	Reckord and Batley,	50	36	1.59	1.20	56	Wading msmt. 65′ above gage.

DAILY MEAN GAGE HEIGHTS OF DARBY CREEK, AT LANSDOWNE, DELAWARE COUNTY, PENNSYLVANIA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	1.58	1.45	1.25	1.15	1.20	1.20	0.95	1.40	1.21	0.98	1.10	1.19
2,	1.10	1.48	0.96	1.40	1.35	1.33	1.06	1.40	1.11	1.11	1.12	1.10
3,	1.25	1.46	1.12	1.60	1.80	1.55	0.98	1.38	1.04	1.14	1.20	1.06
4,	1.36	1.54	1.05	1.30	1.31	1.23	1.08	1.41	1.16	1.12	1.08	1.15
5,	1.32	1.38	1.19	1.20	1.40	1.26	0.93	1.41	1.05	1.12	1.08	1.20
6,	1.40	1.45	1.26	1.16	1.80	1.66	0.92	1.40	0.92	1.10	1.06	1.46
7,	1.38	1.46	1.26	1.20	1.55	1.46	1.16	1.41	1.02	0.96	f3.11	1.20
8,	1.25	1.38	1.30	1.30	2.00	1.21	1.01	1.38	1.20	1.10	1.20	1.21
9,	1.80	1.50	1.32	1.35	1.20	1.30	0.94	1.40	0.82	0.91	1.10	1.18
10,	1.28	1.60	1.40	1.30	1.08	1.12	0.91	1.40	0.82	0.93	1.20	1.10
11,	1.18	1.52	1.22	1.48	1.12	1.20	0.95	1.45	0.94	1.04	1.08	1.08
12,	1.42	1.70	2.08	1.32	1.40	1.16	0.92	1.36	0.85	1.20	1.05	1.10
13,	1.60	1.58	2.95	1.32	1.20	1.15	0.98	1.35	0.94	1.20	1.12	1.18
14,	1.65	1.50	1.22	1.32	1.16	1.15	c2.15	1.44	1.00	1.11	1.06	1.16
15,	1.52	1.60	b4.95	1.35	1.20	1.14	1.58	1.30	1.11	1.02	1.08	1.20
16,	1.48	1.66	1.20	1.21	1.26	1.56	0.96	1.32	1.12	0.92	1.00	1.10
17,	1.60	1.68	1.20	1.35	1.91	1.25	0.93	1.30	1.05	1.04	1.23	1.11
18,	1.42	2.06	1.10	1.82	1.70	1.11	1.28	1.32	1.08	1.11	1.04	1.38
19,	3.95	1.82	1.21	1.65	1.80	1.18	0.98	1.28	0.81	1.10	1.11	1.18
20,	1.83	1.74	1.50	1.32	1.15	1.11	1.12	1.31	0.72	1.22	1.20	1.20
21,	1.60	4.15	2.01	1.50	1.11	1.18	1.48	1.30	1.00	1.14	1.15	1.15
22,	1.38	2.30	1.25	1.32	1.22	1.12	1.15	1.32	1.02	0.78	1.12	1.15
23,	1.40	1.64	1.12	1.35	1.30	1.30	0.98	1.20	1.10	e2.61	1.11	1.15
24,	1.32	1.32	2.90	1.22	1.28	1.15	0.94	1.18	d2.21	1.22	1.34	1.20
25,	1.32	1.50	1.18	1.31	1.33	1.15	1.06	1.30	1.62	1.14	1.08	1.12
26,	1.35	a4.20	1.20	1.30	1.30	1.19	1.11	1.11	1.33	1.24	1.05	1.16
27,	1.42	2.15	1.25	1.28	1.12	1.22	1.20	0.90	1.10	1.25	1.12	1.75
28,	1.51	1.12	1.22	1.50	1.30	1.03	1.25	0.86	0.97	1.10	1.16	1.22
29,	1.53	1.15	2.70	1.40	1.20	1.15	1.19	0.95	1.10	1.12	1.20	1.21
30,	1.45	....	1.30	1.32	2.12	1.25	1.23	1.01	1.05	1.17	1.08	g8.16
31,	1.50	....	1.40	....	1.25	....	1.82	1.15	....	1.14	....	1.31

aMax. 9.00′ at 1:00 A. M. bMax. 7.4′ at 6:00 P. M. cMax. 3.2′ at 6:00 P. M. dMax. 2.8′ at 6:00 P. M. eMax. 3.02′ at 6 A M. .fMax. 5.02′ at 6:00 P. M.
gMax. 4.82′ at 6:00 P. M.

BRANDYWINE CREEK.

DESCRIPTION OF BASIN.

Brandywine creek, a large tributary of the Delaware river, in Pennsylvania, which passes through the northern part of the State of Delaware, and enters the river just below Wilmington, drains approximately 300 square miles in Pennsylvania. Rising in two branches, the east and west, which head on the western edge of Chester county, in the Welsh Mountains, within a few miles of each other, these branches diverge, one passing through Downingtown, and the other through Coatesville, about 10 miles apart, and then meet about one mile north of Lenape, in the south-central part of Chester county. The stream and its branches flow in a general southerly direction through a rolling country, thickly populated, well developed agriculturally and practically deforested, its total length in Pennsylvania being about 35 miles. The elevation of the sources of the two branches is about 900 feet; at the State line it is 140 feet, and at the mouth sea level. The slope of the stream is gradual, but steep enough to cause small waterpowers to be extensively developed along it and its branches. On the drainage basin lie numerous towns and villages, several of which obtain water from the branches. The average yearly rainfall over this watershed is from 45 to 50 inches.

The flow of this stream has been measured since August 1st, 1911, at Chadds Ford, near the Pennsylvania-Delaware State line, about 10 miles above the mouth, the drainage area above the gage being approximately 285 square miles.

DELAWARE BASIN—STATION NO. 19.

BRANDYWINE CREEK AT CHADDS FORD.

DESCRIPTION OF STATION.

This station was established on August 1st, 1911, by the Water Supply Commission of Pennsylvania. It is located on a two-span, iron girder bridge of the Pennsylvania Railroad, with foot-path along the upstream side, which crosses the creek at this point. A standard chain gage is bolted to the rail of the foot pathway, on the upstream side in the left span. The length of chain from center of rivet to bottom of weight is 24.00 feet.

Discharge measurements are made from the foot-path at all times as wading is practically impossible on account of the depth of water. The initial point for soundings is a cross mark cut in the hand rail near face of left abutment. The bench mark is outside upstream corner of left bridge seat stone; elevation 18.49 feet above zero of gage. The channel above the bridge is straight for 150 feet, then curves to the west, the tail race of a mill entering the stream on the left bank about 150 feet above the bridge; below the bridge the channel is straight for 250 feet, and then curves to the west. The bed of the stream is mud, gravel and stones, and fairly permanent. The left bank of the stream at the bridge is the railroad embankment, and abutment, and is high and steep, and does not overflow. The right bank of the creek proper is low and flat and at high stages water floods over a flat 600 feet wide, under the wooden trestle of the Pennsylvania Railroad. From this trestle in high water periods it will be necessary to measure the overflow water. The gage is read twice daily by E. J. Reynolds.

Since the establishment of this station 6 discharge measurements have been made. No rating curve has been determined, and only the discharge measurements and gage heights have been published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BRANDYWINE CREEK, AT CHADDS FORD, DELAWARE COUNTY, PENNA.

(Drainage area 285 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
5	1912 July 3,	Langenheim, ...	107	302	0.76	1.29	229	0.6 msmt.
6	1913 Feb. 19,	Reckord and Batley,	106	366	1.00	1.73	365	0.6 msmt.

DAILY MEAN GAGE HEIGHTS OF BRANDYWINE CREEK AT CHADDS FORD, DELAWARE COUNTY, PENNA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	2.34	1.90	1.86	2.46	2.24	1.60	1.47	1.80	1.02	1.16	1.46	1.26
2,	2.14	1.70	1.70	2.40	1.94	1.56	1.32	1.30	1.67	1.12	1.46	1.32
3,	2.10	1.73	1.62	d3.08	1.80	1.87	1.28	1.16	1.22	1.14	1.36	1.58
4,	2.04	1.75	1.60	2.34	1.78	1.57	1.25	1.04	1.06	1.09	1.28	1.42
5,	1.92	2.36	1.56	2.31	1.68	1.52	1.22	1.03	1.06	1.08	1.28	1.44
6,	Frozen,	1.88	1.58	2.24	1.94	2.20	1.20	1.02	1.08	1.06	1.28	1.58
7,	Frozen,	1.73	1.96	2.40	1.96	f2.96	1.19	1.04	1.06	1.09	m2.34	1.50
8,	Frozen,	1.66	2.10	2.34	3.27	1.92	1.19	1.02	1.00	1.02	2.80	1.32
9,	Frozen,	1.56	1.78	2.24	2.24	1.64	1.18	1.17	1.04	1.08	2.00	1.34
10,	Frozen,	1.53	1.66	2.04	2.00	1.61	1.14	g2.76	0.96	1.08	1.62	1.30
11,	Frozen,	1.52	1.62	2.03	1.81	1.52	1.18	3.11	0.98	1.08	1.46	1.32
12,	Frozen,	1.52	2.30	1.98	1.88	1.50	1.33	1.67	0.99	1.05	1.46	1.30
13,	Frozen,	1.51	c7.78	2.00	1.92	1.49	1.21	1.41	0.97	1.01	1.30	1.28
14,	Frozen,	1.47	2.86	2.12	1.80	1.44	1.18	1.33	0.92	1.04	1.72	1.26
15,	Frozen,	1.44	6.12	2.00	1.78	1.42	1.82	1.24	0.91	0.92	1.54	1.20
16,	Frozen,	1.60	4.76	2.18	e2.91	1.58	1.42	1.22	1.08	1.00	1.42	1.30
17,	Frozen,	1.66	3.06	2.07	3.06	1.60	1.58	1.16	1.02	0.96	1.38	1.30
18,	2.08	2.06	2.98	2.42	2.16	1.72	1.92	1.30	0.98	0.96	1.38	1.32
19,	a4.97	2.20	2.63	2.47	2.08	1.52	1.65	1.22	1.02	1.00	1.34	1.66
20,	3.62	2.30	3.14	2.23	1.94	1.46	1.32	1.30	1.13	1.00	1.33	1.73
21,	2.26	4.68	2.96	1.97	1.85	1.42	2.08	1.18	1.02	1.01	1.34	1.42
22,	2.14	b8.08	2.48	1.94	1.79	1.39	1.96	1.15	0.94	0.98	1.32	1.34
23,	2.05	2.44	2.40	2.03	1.76	1.34	1.48	1.64	1.09	k4.48	1.31	1.31
24,	2.36	2.03	4.67	1.86	1.78	1.35	1.30	1.26	2.20	3.66	1.56	1.34
25,	1.92	1.91	4.12	1.80	1.70	1.32	1.34	1.10	h5.01	2.10	1.78	1.42
26,	1.85	2.73	2.64	1.82	1.68	1.36	1.28	1.09	1.98	1.64	1.46	1.46
27,	1.90	5.54	2.26	1.87	1.64	1.40	1.73	1.06	1.50	1.43	1.36	2.08
28,	1.88	2.64	2.10	1.96	1.61	1.34	1.18	1.02	1.88	1.34	1.34	1.79
29,	1.84	1.98	5.48	2.00	1.66	1.32	1.15	1.05	1.28	1.30	1.31	n1.68
30,	1.77	....	3.14	2.62	2.02	1.57	1.14	1.04	1.20	1.26	1.30	4.08
31,	1.74	....	2.62	....	1.68	....	1.10	1.08	....	1.22	....	4.28

a Max. 5′.35 at 4:30 P. M. b Max. 9′.92 at 9:30 A. M. c Max. 11′.00 at 6:00 A. M. d Max. 3′.42 at 9:30 A. M. e Max. 3′.83 at 4:30 P. M. f Max. 3′.36 at 9:30 A. M. g Max. 4′.09 at 4:30 P. M. h Max. 5′.70 at 9:30 A. M. k Max. 4′.61 at 4:30 P. M. m Max. 3′.39 at 4:00 P. M. n Max. 6′.43 at 4:00 P. M.

SUSQUEHANNA BASIN

GAGING STATIONS IN SUSQUEHANNA BASIN.

No.	Stream.	Location.	Established	Discontinued.	Re-established.	1912 Information Available.
1.	Chenango river,	Binghamton, N. Y.,	July 31, 1901,	Dec. 31, 1911,		Discharge msmts.
2.	North Br. Susquehanna river,	Binghamton, N. Y.,	July 31, 1901,			Discharge complete.
3.	Chemung river,	Chemung, N. Y.,	Sept. 7, 1903,			Discharge complete.
4.	Wyalusing creek,	Wyalusing, Pa.,	Oct. 28, 1903,			Discharge complete.
5.	Lackawanna river,	Scranton, Pa.,	July 1, 1908,	Sept. 16, 1911,	Feb. 2, 1912,	Discharge msmts. and rating table.
6.	North Br. Susquehanna river,	Wilkes-Barre, Pa.,	March 30, 1899,			Discharge complete.
7.	North Br. Susquehanna river,	Danville, Pa.,	March 25, 1899,	March 9, 1904,	March 24, 1905,	Discharge complete.
8.	West Br. Susquehanna river,	Renovo, Pa.,	Sept. 1, 1905,			Discharge complete.
9.	Bald Eagle Creek,	Milesburg, Pa.,	Feb. 6, 1911,			Discharge complete.
10.	Spring creek,	Bellefonte, Pa.,	Feb. 7, 1911,			Discharge complete.
11.	Bald Eagle creek,	Beech Creek, Pa.,	June 23, 1910,			Discharge msmts. and gage heights.
12.	Pine creek,	Waterville, Pa.,	July 15, 1908,			Discharge complete.
13.	Lycoming creek,	Williamsport, Pa.,	July 14, 1908,			Discharge complete.
14.	West Br. Susquehanna river,	Williamsport, Pa.,	March 1, 1895,			Discharge complete.
15.	Loyalsock creek,	Forksville, Pa.,	July 17, 1908,			Daily gage heights.
16.	Raystown Br., Juniata river,	Saxton, Pa.,	August 31, 1911,			Discharge msmts. and gage heights.
17.	Frankstown Br., Juniata river,	Huntingdon, Pa.,	May 1, 1895,			Discharge complete.
18.	Kishacoquillas creek,	Kulp's, Pa.,	August 21, 1911,			Discharge complete.
19.	Tuscarora creek,	Port Royal, Pa.,	August 21, 1911,			Discharge complete.
20.	Juniata river,	Newport, Pa.,	March 21, 1899,	July 14, 1906,	Jan. 7, 1907,	Discharge complete.
21.	Conodoguinet creek,	Hogestown, Pa.,	Sept. 26, 1911,			Discharge complete.
22.	Susquehanna river,	Harrisburg, Pa.,	Jan. 1, 1891,			Discharge complete.
23.	Yellow Breeches creek,	White Hill, Pa.,	March 22, 1909,	Oct. 31, 1909,	Jan. 22, 1910,	Discharge complete.
24.	Big Swatara creek,	Jonestown, Pa.,	Nov. 19, 1910,			Discharge complete.

CHENANGO RIVER.

DESCRIPTION OF BASIN.

Chenango river rises in the central part of Madison county, New York, and flows southward into the Susquehanna river at Binghamton, N. Y. It is approximately seventy miles long and its drainage area comprises about 1,580 square miles. Its headwater valleys lie at an elevation of about 1,200 feet above sea level, and its mouth is 864 feet above tide. Its bed is, as a rule, composed of sand and gravel and the stream is bordered, in many places, by bottom land, subject to overflow. A portion of the headwaters are diverted across the Chenango-Mohawk Divide, through Oriskany creek, to feed the summit level of the Erie Canal.

Considerable power is developed at Binghamton and at Port Dickinson, three miles above.

The mean annual precipitation over this water shed is from 35 to 40 inches.

The discharge of this stream was measured from July 31st, 1901, to December 31st, 1911, at Binghamton, N. Y., near its mouth, although several discharge measurements were obtained during 1912.

SUSQUEHANNA BASIN—STATION NO. 1.

CHENANGO RIVER AT BINGHAMTON, N. Y.

DESCRIPTION OF STATION.

This station was established July 31st, 1901, by the United States Geological Survey, and was maintained through co-operation with the New York State Engineer until December 31st, 1911, when the station was discontinued. There were, however, several discharge measurements taken during 1912, as well as gage heights for a short period, the latter being unreliable and the station discontinued as above stated. It was located on the Court Street Bridge, at Binghamton, N. Y.

The channel was obstructed by three masonry piers. A small rift between the station and the confluence of Chenango river with the Susquehanna river, about 2,500 feet below cuts off back water at ordinary stages of the rivers. The bridge crosses the stream at right angles and the bed is of gravel and small cobble stones, there being a smooth, uniform current.

Discharge measurements were made from the Court Street Bridge. A boxed wire gage was fastened to the vertical supports of the hand-rail on the upstream side of the first span from the right bank. The bench mark was a circular chiselled draft on the upstream corner of the bridge seat on the left abutment, its elevation being 34.02 feet above gage datum.

In estimating the run-off of Chenango river, the area directly tributary to storage reservoirs, from which diversion is made to supply the Erie Canal, has been deducted from the total natural drainage area. The diversion area of six reservoirs at the head of Chenango river, whose outflow is turned into the Erie Canal through Limestone creek, is 30 square miles. The diversion area of De Ruyter reservoir, at the head of Tioghnigo river, whose outflow is turned into the Erie Canal through Limestone creek, is 18 square miles. These two areas have been subtracted from the natural drainage area of 1,580 square miles, giving an effective area of 1,532 square miles. This estimate is approximate, as no allowance for direct inflow to feeder channels from additional areas, nor for waste into the original stream, has been made. The gross area from which more or less run-off is diverted is about 105 square miles.

There is a low dam about one mile upstream from the gaging station. For periods during freshets, or at times when there is an abnormal rise on one stream, accompanied by a similar rise in the other stream, either the Chenango or Susquehanna river record at Binghamton may be affected by backwater, indicating a too great discharge. For freshets of considerable duration the flow of the two streams will be more nearly equalized. During the winter months the discharge is usually very little affected by the presence of ice.

Since the establishment of this station 57 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CHENANGO RIVER, AT BINGHAMTON, N. Y.

(Drainage area, 1,530 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
53	Feb. 21,	De Golyer, ...	295	700	1.93	6.21	1350	Open water msmt. with some ice at control.
54	Mar. 17,	Covert, ...	308	3960	2.93	15.28	11600	Pronounced back water effect from high water in Susquehanna.
55	Mar. 20,	Covert, ...	308	3350	4.72	14.46	15800	
56	April 5,	Weber, ...	308	2190	3.82	11.04	8350	
57	April 6,	Weber, ...	308	2610	5.06	12.67	13200	

NORTH BRANCH OF SUSQUEHANNA RIVER.

DESCRIPTION OF BASIN.

The North Branch of the Susquehanna river, which joins the West Branch at Northumberland to form the main Susquehanna river, drains a total area of 11,485 square miles, of which 6,270 lie in Pennsylvania, and 5,215 in New York State. This Branch rises in the Catskill Mountains, in southeastern New York, close to the headwaters of the Delaware river, flows in a general southwesterly course into Pennsylvania near the northeastern corner of the state, and, forming a loop about 16 miles in length, again enters New York state, where it continues westerly, finally turning southward into Pennsylvania, just north of Sayre, Bradford county, and follows a southeasterly course to Wilkes-Barre, and thence southwesterly to its junction with the West Branch. The total length of the river, to the forks at Oneonta, N. Y., is approximately 290 miles. From its headwaters to near where it crosses into Pennsylvania for the second time, this stream flows through a well populated, agricultural area, the mountains being fairly well covered with second growth timber, the channel lying in a narrow valley. Just above Sayre the river flows through a wide, open, thickly settled, farming country, but as it enters Pennsylvania it changes to a narrow valley, bounded by hills 400 to 600 feet high, and thus continues, passing now and then through broad flats, to its mouth.

The upper part of the watershed in Pennsylvania is thinly inhabited and not extensively farmed, the mountains being usually covered with second growth timber, but from the mouth of the Lackawanna river, 10 miles above Wilkes-Barre, to its mouth, the basin is densely settled. In this section lies the Wyoming Valley anthracite coal field. Four cities, Pittston, Scranton, Carbondale and Wilkes-Barre, many large boroughs and numerous farming and mining villages are found in this drainage area in Pennsylvania, besides which some cities and boroughs of New York State also lie in this watershed.

The slope of the stream in Pennsylvania is not steep, flowing, as it does, through a succession of rapids and pools, and follows a uniform rate of about two feet per mile to its mouth. All but a small portion of the basin, near the mouth, lies within the glacial area. The sub-basins, lying within the glacial area, abound in lakes, ponds and swamps, and a few of these basins are still well forested.

The principal tributaries in New York are the Chenango and Unadilla rivers, and in Pennsylvania the Chemung and Lackawanna rivers, Towanda, Wyalusing, Tunkhannock and Fishing creeks.

Numerous domestic water supplies are taken from tributaries of the North Branch and a few from the parent stream, which is also used to some extent for industrial purposes. Water power is developed only to a limited extent.

For many years the large coal mining companies in this region have been dumping culm and refuse matter into the river and its tributaries, until at the present time the pools and many channels between the mouth of the Lackawanna river and Sunbury are filled to depths varying from four to 25 feet, thus obstructing the flow, polluting the river and, in time of floods, causing damage, both by reason of the blocking of the channels and of the culm being deposited on valuable farm lands.

The river is not used for navigation, being too shallow and swift.

Over the greater portion of this basin there is an average annual precipitation of 35 to 40 inches, while a small strip to the southeast of the stream, from Northumberland to Scranton, receives from 40 to 45 inches.

The flow has been measured at Binghamton, N. Y., since July 31, 1901; at Wilkes-Barre, Pa., since March 30, 1899, 67 miles above the mouth; and at Danville, Pa., since March 25, 1899, 12 miles above the mouth.

SUSQUEHANNA BASIN—STATION NO. 2.

NORTH BRANCH OF SUSQUEHANNA RIVER AT BINGHAMTON, N. Y.

DESCRIPTION OF STATION.

This station was established July 31st, 1901, by the United States Geological Survey, and has since been maintained in co-operation with the New York State Engineer. It is located at the Washington Street Bridge, about 800 feet upstream from the junction of Chenango and Susquehanna rivers.

The channel is straight for about 500 feet above and below the bridge, and is about 300 feet wide at low water and about 450 feet wide at high water. The bed is of gravel and small stones.

Discharge measurements are made from the Exchange Street Bridge, 1,900 feet upstream from the Washington Street Bridge, on account of the unfavorable conditions produced by a rift which extends diagonally across the stream underneath the latter bridge.

A standard chain gage is attached to the upstream side of the left span of the Washington Street Bridge. The gage is upstream from the crest of the rift and over a stretch of smooth water extending to a dam about 2,800 feet above. The length of chain from the bottom of weight to the marker is 26.17 feet; the elevation of zero is arbitrary. The Bench Mark is a chiselled draft on the corner of the left bridge abutment, on the upstream side; elevation 23.71 feet above gage datum. The gage is read twice daily.

During the winter months the discharge is usually affected but little by the ice conditions. High water estimates are liable to considerable error, due to backwater conditions from ice jams, which form near Willow Point and also from high water conditions in the Chenango.

Since the establishment of this station 57 discharge measurements have been made.

The following data have been furnished by the Unites States Geological Survey. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF NORTH BRANCH SUSQUEHANNA RIVER, AT BINGHAMTON, N. Y.

(Drainage area 2,400 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
52	Mar. 17,	Covert, ...	374	4100	5.88	10.68	24100	From Exchange Street bridge.
53	Mar. 19,	McMillan, ...	364	3870	4.47	9.68	16300	From Exchange Street bridge.
54	Mar. 20,	McMillan, ...	367	4130	4.77	10.67	19500	From Exchange Street bridge.
55	April 6,	Weber, ...	352	3340	4.21	8.70	13780	From Exchange Street bridge.
56	April 7.	Weber, ...	362	3970	4.54	10.40	18000	From Exchange street bridge.
57	July 24,	Weber, ...	236	815	1.18	1.87	855	Wading measurement.

DISCHARGE TABLE FOR NORTH BRANCH SUSQUEHANNA RIVER, AT BINGHAMTON, N. Y. FROM JAN. 1, 1911, TO DEC. 31, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.70	210	.30	5850	.90	13250	.50	21400	.10	30200
.80	300	.40	6120	7.00	13550	.60	21730	.20	30550
.90	410	.50	6390	.10	13860	.70	22060	.30	30900
2.00	540	.60	6660	.20	14170	.80	22390	.40	31250
.10	690	.70	6930	.30	14480	.90	22720	.50	31600
.20	860	.80	7200	.40	14790	10.00	23050	.60	31960
.30	1050	.90	7480	.50	15100	.10	23380	.70	32320
.40	1240	5.00	7760	.60	15410	.20	23710	.80	32680
.50	1440	.10	8040	.70	15720	.30	24040	.90	33040
.60	1650	.20	8320	.80	16030	.40	24370	13.00	33400
.70	1870	.30	8600	.90	16340	.50	24700	.10	33760
.80	2100	.40	8880	8.00	16650	.60	25040	.20	34120
.90	2330	.50	9160	.10	16960	.70	25380	.30	34480
3.00	2570	.60	9440	.20	17210	.80	25720	.40	34840
.10	2810	.70	9720	.30	17580	.90	26060	.50	35200
.20	3050	.80	10010	.40	17890	11.00	26400	.60	35560
.30	3290	.90	10300	.50	18200	.10	26740	.70	35920
.40	3540	6.00	10590	.60	18520	.20	27080	.80	36280
.50	3790	.10	10880	.70	18840	.30	27420	.90	36640
.60	4040	.20	11170	.80	19160	.40	27760	14.00	37000
.70	4290	.30	11460	.90	19480	.50	28100	.10	37360
.80	4540	.40	11750	9.00	19800	.60	28450	.20	37720
.90	4800	.50	12050	.10	20120	.70	28800	.30	38080
4.00	5060	.60	12350	.20	20440	.80	29150	.40	38440
.10	5320	.70	12650	.30	20760	.90	29500		
.20	5580	.80	12950	.40	21080	12.00	29850		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF NORTH BRANCH SUSQUEHANNA RIVER AT BINGHAMTON, NEW YORK.

DAY.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
1912	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.3	3290	2.5	1440	4.7	6930	11.7	28800	5.0	7760	2.8	2100	2.0	540	1.9	410	2.1	690	3.5	3790	3.2	3050	3.0	2570
2, ...	3.4	3540	2.5	1440	4.1	5320	13.3	34500	4.3	5850	2.7	1870	2.0	540	1.9	410	3.5	3790	3.4	3540	3.2	3050	3.0	2570
3, ...	3.2	3050	3.0	2570	3.8	4540	13.2	34100	3.8	4540	2.7	1870	2.0	540	1.9	410	3.1	2810	3.1	2810	3.2	3050	7.6	15400
4, ...	3.1	2810	2.5	1440	3.6	4040	9.0	19600	3.3	3290	2.9	2330	2.0	540	1.8	300	2.6	1650	2.9	2330	3.1	2810	7.6	15400
5, ...	2.9	2330	3.2	3050	3.1	2810	7.4	10600	3.2	3050	2.8	2100	2.0	540	1.9	410	2.5	1440	2.8	2100	2.9	2330	6.0	10600
6, ...	2.8	2100	2.9	2330	3.1	2810	8.8	18700	3.2	3050	2.7	1870	2.0	540	1.9	410	2.5	1440	2.7	1870	2.8	2100	5.6	9440
7, ...	2.9	2330	2.4	1240	2.6	1650	10.2	18000	3.2	3050	2.7	1870	2.0	540	1.9	410	2.4	1240	2.6	1650	2.8	2100	6.4	11800
8, ...	3.4	3540	2.6	1650	2.7	1870	12.0	22400	3.4	3540	2.6	1650	2.0	540	1.9	410	2.3	1050	2.5	1440	6.8	13000	5.6	9440
9, ...	3.3	3290	3.0	2570	3.5	3790	10.9	21400	3.5	3790	2.5	1440	2.0	540	1.9	410	2.3	1050	2.5	1440	7.1	13900	4.7	6930
10, ...	3.7	4290	3.0	2570	4.0	5060	8.7	18800	3.4	3540	2.4	1240	2.0	540	1.8	300	2.2	860	2.5	1440	5.9	10800	4.1	5320
11, ...	4.2	5580	2.4	1240	3.8	4540	7.4	14800	3.3	3290	2.4	1240	2.0	540	2.1	690	2.2	860	2.4	1240	4.9	7480	3.7	4290
12, ...	3.8	4540	2.7	1870	3.1	2810	7.1	13900	3.1	2810	2.4	1240	2.0	540	2.0	540	2.2	860	2.5	1440	4.4	6120	3.5	3790
13, ...	3.4	3540	2.5	1440	3.5	3790	7.0	13600	3.3	3290	2.3	1050	2.0	540	2.2	860	2.2	860	2.6	1650	4.0	5060	3.2	3050
14, ...	3.4	3540	2.4	1240	4.2	5580	6.9	13200	3.1	2810	2.3	1050	1.9	410	2.1	690	2.1	690	2.6	1650	3.9	4800	2.7	1870
15, ...	3.2	3050	2.5	1440	5.0	7760	6.2	11200	2.9	2330	2.3	1050	2.0	540	2.1	690	2.1	690	2.7	1870	4.0	5060	2.9	2330
16, ...	3.4	3540	2.4	1240	8.2	17300	8.3	17600	2.9	2330	2.2	860	1.9	410	2.0	540	2.3	1050	2.6	1650	3.8	4540	3.1	2810
17, ...	3.1	2810	2.2	860	11.3	27400	7.7	15700	3.9	4800	2.2	860	2.0	540	2.0	540	2.2	860	2.5	1440	3.6	4040	3.0	2570
18, ...	2.8	2100	2.2	860	10.0	19800	7.2	14200	4.3	5850	2.2	860	2.0	540	1.9	410	2.5	1440	2.5	1440	3.4	3540	2.9	2330
19, ...	2.8	2100	2.3	1050	9.8	16300	7.4	14800	4.0	5060	2.2	860	1.9	410	2.0	540	2.5	1440	2.5	1440	3.3	3290	3.1	2810
20, ...	3.4	3540	2.4	1240	10.7	18000	7.1	13900	3.5	3790	2.2	860	1.9	410	2.0	540	2.5	1440	2.4	1240	3.2	3050	4.7	6930
21, ...	3.0	2570	2.8	2100	9.1	17300	6.0	10600	3.2	3050	2.2	860	1.9	410	2.0	540	2.6	1650	2.5	1440	3.1	2810	4.4	6120
22, ...	3.3	3290	4.0	5060	7.0	13900	5.2	8320	3.1	2810	2.2	860	1.9	410	2.1	690	2.6	1650	2.4	1240	3.1	2810	3.7	4290
23, ...	3.1	2810	5.1	8040	5.5	9160	5.4	8880	3.0	2570	2.2	860	1.9	410	2.4	1240	2.5	1440	2.4	1240	3.0	2570	3.4	3540
24, ...	2.9	2330	4.8	7200	5.1	8040	5.7	9720	3.1	2810	2.1	690	1.9	410	2.5	1440	2.8	2100	2.6	1650	3.0	2570	3.2	3050
25, ...	3.2	3050	4.6	6660	4.6	6660	5.2	8320	2.9	2330	2.1	690	1.9	410	2.4	1240	5.1	8040	6.8	13000	3.1	2810	3.1	2810
26, ...	2.8	2100	4.9	7480	4.0	5060	4.7	6930	2.8	2100	2.1	690	1.9	410	2.8	2100	5.3	8600	6.1	10900	3.3	3290	2.9	2330
27, ...	2.6	1650	5.1	8040	3.7	4290	4.2	5580	2.7	1870	2.1	690	1.9	410	2.5	1440	4.7	6930	4.9	7480	3.4	3540	3.0	2570
28, ...	2.6	1650	5.7	9720	3.9	4800	4.0	5060	2.6	1650	2.0	540	1.9	410	2.3	1050	4.1	5320	4.3	5850	3.3	3290	2.9	2330
29, ...	2.5	1440	5.7	9720	7.4	14800	3.8	4540	2.6	1650	2.1	690	1.9	410	2.2	860	3.4	3540	3.8	4540	3.2	3050	2.8	2100
30, ...	2.5	1440	....	......	13.0	33400	5.2	8320	2.9	2330	2.0	540	1.9	410	2.1	690	3.6	4040	3.6	4040	3.1	2810	3.0	2570
31, ...	2.5	1440	....	......	11.8	29200	....	......	3.3	3290	....	......	1.9	410	2.1	690	....	......	3.4	3540	....	......	3.6	4040

Note.—The discharge has been reduced on those days when the gage heights were affected by backwater from the Chenango River.

ESTIMATED MONTHLY DISCHARGE OF N. BR. SUSQUEHANNA RIVER AT BINGHAMTON, N. Y.

(Drainage area, 2,400 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	5580	1440	2860	1.190	1.370
February,	9720	860	3340	1.390	1.500
March,	33400	1650	9960	4.150	4.780
April,	34500	4520	14700	6.120	6.830
May,	7760	1650	3360	1.400	1.610
June,	2330	540	1180	0.492	0.550
July,	540	410	477	0.199	0.230
August,	2100	300	706	0.294	0.340
September,	8600	690	2320	0.967	1.080
October,	13000	1240	2980	1.240	1.430
November,	13900	2100	4410	1.840	2.050
December,	15400	1870	5100	2.120	2.410
The year,	34500	300	4280	1.784	24.210

Note.—The discharge has been reduced on those days when the gage heights were affected by backwater from the Chenango River.

CHEMUNG RIVER.

DESCRIPTION OF BASIN.

The Chemung river is formed near Painted Post, in the southeastern part of Steuben county, N. Y., by the confluence of Cohocton and Tioga rivers. Cohocton river, the north branch, drains the opposite or southern slope of the divide at the head of Keuka and Canadaigua Lakes. Its drainage area lies wholly in the State of New York, principally in Steuben county and comprises approximately 630 square miles above the mouth. Tioga river rises in Tioga county, Penn'a, and flows northward, crossing the state line near Lawrenceville, Penn'a. The last fifteen miles of its course lie in New York State. It has about 1,330 square miles of drainage area above its mouth, 689 of which lie in Penn'a. About five miles from its mouth the Tioga river receives, from the left, Canisteo river, which rises in the northeast corner of Allegheny county, N. Y., and flows in a southeasterly direction, draining, with its tributaries, the southern part of Steuben county. Its drainage area comprises about 540 square miles.

The Chemung river flows southeastward through Corning, Elmira and Chemung, crosses the state line and flows for approximately two and one-half miles in Penn'a, returns to New York for approximately two and one-half miles, and crosses again to Penn'a near

Waverly, emptying into the Susquehanna river near Athens, Bradford county, Penn'a. The total length of the river proper is about forty miles, of which thirty miles lie in New York; the drainage area at the mouth being approximately 2,520 square miles, 832 of which are in Pennsylvania.

The Chemung river is sluggish throughout its course, flowing over a wide, gravelly bed, in a series of rifts and pools, and one or the other of the banks is usually low and subject to frequent overflow. The hills bordering the river rise to a height of several hundred feet on either side, within a short distance of the stream. The upland plateau is, to a large extent, wooded, has impervious soil, no lake storage and few marsh areas. Tributaries are ramifying and uniformly distributed, though not very numerous, and dry gullies, or flood channels, are common. The principal tributaries in Pennsylvania are Seely creek, South creek and Bently creek, all of which join the river in New York State.

In its watershed in Pennsylvania lie the boroughs of Athens, Sayre and South Waverly, while in New York are Corning, Elmira, Chemung and Waverly.

The mean annual precipitation over this watershed is from 35 to 40 inches.

The discharge of this stream has been measured since Sept. 7, 1903, at Chemung, approximately 10 miles above its mouth.

SUSQUEHANNA BASIN—STATION NO. 3.

CHEMUNG RIVER AT CHEMUNG, N. Y.

DESCRIPTION OF STATION.

This station, established September 7th, 1903, by the United States Geological Survey, and maintained through co-operation with the New York State Engineer, is located at a two span, steel truss bridge, midway between Chemung, N. Y., and Willawanna, Penn'a, near the state line.

The channel is straight for 700 feet above and 800 feet below the station. The right bank is high, cleared and not subject to overflow; the left bank is medium height, wooded, and overflows at high water. The bed of the stream is composed of gravel and is permanent. The current is good. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the bridge. Initial point for soundings is the face of the right abutment on the downstream side.

A tape and weight gage is attached to the upstream side of the bridge, near the right bank, and is read twice daily. The length of the tape from the bottom of weight to the marker is 29.58 feet. The elevation of zero is arbitrary. Bench Mark No. 1 is formed by three nails driven into a telegraph pole 70 feet to the right of the initial point for soundings and about 30 feet upstream. The pole is marked with black paint "U. S. G. S. B. M."—elevation 29.88 feet above gage datum.

The suspension bridge to which the gage was originally attached was removed during the summer of 1911, and on April 19, 1911, the gage was placed 250 feet upstream from the bridge. Readings were taken on this gage from this latter date until February 19, 1912, when the gage was replaced on the new structure on the original datum.

The smooth water reaches of the stream become ice covered in winter. Needle ice forms over the rapids and is carried under the surface ice. Much of the winter flow apparently filters through these beds of needle ice at times. The conditions render estimates of the daily discharge in winter impracticable.

Since the establishment of this station 39 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CHEMUNG RIVER, AT CHEMUNG, N. Y.

(Drainage area, 2,440 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
33	Feb. 19,	DeGolyer, ...	225	392	0.64	3.08	252	Measurement under ice cover.
34	Mar. 16,	Covert & McMillan, .	392	3900	6.56	12.08	25600	
35	Mar. 18,	Covert & McMillan, .	388	3400	5.30	10.51	18000	
36	Mar. 25,	Canfield, ...	282	1340	1.85	4.35	2480	
37	April 3,	Weber, ...	394	3300	5.49	9.84	18100	
38	April 4,	Weber, ...	375	2880	4.27	8.12	12300	
39	July 20,	Weber, ...	224	290	0.97	2.07	282	Wading msmt 500′ below gage.

Note.—All measurements except that of February 19, referred to gage on new bridge.

DISCHARGE TABLE FOR CHEMUNG RIVER AT CHEMUNG, N. Y., FROM JAN. 13, 1911.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.40	39	4.00	2020	.60	7570	.20	16000	.80	27000
.50	53	.10	2160	.70	7840	.30	16400	.90	27500
.60	75	.20	2310	.80	8120	.40	16800	12.00	28000
.70	105	.30	2470	.90	8410	.50	17200	.10	28500
.80	140	.40	2630	7.00	8700	.60	17600	.20	29000
.90	180	.50	2800	.10	9000	.70	18000	.30	29500
2.00	220	.60	2960	.20	9300	.80	18400	.40	30000
.10	270	.70	3170	.30	9600	.90	18800	.50	30500
.20	320	.80	3360	.40	9900	10.00	19200	.60	31000
.30	370	.90	3560	.50	10200	.10	19600	.70	31500
.40	430	5.00	3760	.60	10500	.20	20000	.80	32000
.50	490	.10	3960	.70	10800	.30	20400	.90	32500
.60	550	.20	4180	.80	11100	.40	20800	13.00	33000
.70	620	.30	4400	.90	11400	.50	21200	.10	33500
.80	690	.40	4620	8.00	11800	.60	21600	.20	34000
.90	770	.50	4840	.10	12100	.70	22000	.30	34500
3.00	860	.60	5060	.20	12500	.80	22400	.40	35000
.10	960	.70	5300	.30	12800	.90	22900	.55	35500
.20	1060	.80	5550	.40	13200	11.00	23400	.60	36000
.30	1160	.90	5800	.50	13500	.10	23800	.70	36500
.40	1270	6.00	6050	.60	13800	.20	24200	.80	37000
.50	1380	.10	6300	.70	14200	.30	24600	.90	37500
.60	1500	.20	6550	.80	14500	.40	25000	14.00	38000
.70	1620	.30	6800	.90	14900	.50	25500		
.80	1750	.40	7050	9.00	15200	.60	26000		
.90	1880	.50	7300	.10	15600	.70	26500		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CHEMUNG RIVER AT CHEMUNG, N. Y.

DAY.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
1912	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.23	1090	....	.....	4.20	2310	11.1	23800	7.8	11100	3.75	1680	2.09	265	1.98	193	2.23	335	4.5	2800	3.00	860	3.30	1160
2, ...	3.23	1090	....	.....	3.75	1680	11.5	25500	6.4	7050	3.35	1220	2.02	280	1.91	184	4.5	2800	4.6	2960	3.05	910	3.35	1220
3, ...	3.11	970	....	.....	3.45	1320	11.1	23800	5.4	4620	4.00	2020	2.00	220	1.96	204	5.1	3960	4.2	2310	2.95	815	6.3	6800
4, ...	3.01	870	....	.....	3.35	1220	8.0	11800	4.8	3360	4.30	2470	1.96	204	1.93	192	4.4	2630	3.85	1820	2.85	780	5.9	5800
5, ...	....	......	....	....	3.25	1110	7.4	9900	4.4	2630	3.60	1500	2.10	270	2.05	245	3.65	1560	3.60	1500	2.85	780	5.1	3960
6, ...	....	......	....	.....	3.00	860	10.2	20000	4.3	2470	3.30	1160	2.08	260	2.08	235	3.60	1500	3.40	1270	2.75	655	5.6	5060
7, ...	....	.....	....	.....	3.00	860	9.0	15200	4.6	2980	3.10	960	2.02	230	1.97	208	3.45	1320	3.25	1110	2.75	655	6.3	6800
8, ...	....	......	....	.....	3.10	960	9.8	13400	4.7	3170	3.00	860	2.03	235	1.95	200	3.15	1010	3.10	960	5.9	5800	5.2	4180
9, ...	....	......	....	.....	4.6	2960	7.5	10200	5.4	4620	2.90	770	2.00	220	2.08	235	2.90	770	2.95	815	5.8	5550	4.6	2980
10, ...	....	......	....	.....	5.0	3760	6.7	7840	5.1	3960	2.75	655	1.92	188	2.08	235	2.75	655	2.95	815	5.1	3960	4.1	2160
11, ...	....	......	....	.....	4.2	2310	6.1	6300	4.7	3170	2.60	550	2.20	320	1.95	200	2.65	585	3.45	1320	4.6	2980	4.1	2160
12, ...	....	......	....	.....	3 9	1880	5.6	5060	4.3	2310	2.60	550	2.40	430	2.08	235	2.70	620	3.75	1680	4.3	2470	3.75	1680
13, ...	....	......	....	.....	3.7	1620	6.8	8120	4.5	2800	2.55	520	2.48	478	2.11	275	2.60	550	3.40	1270	4.0	2020	3.35	1220
14, ...	....	......	....	.....	3.4	1270	6.3	6800	4.7	3170	2.50	490	2.40	430	2.19	315	2.45	460	3.15	1010	4.0	2020	3.15	1010
15, ...	....	......	....	.....	3.9	1880	6.0	6050	4.2	2310	2.49	484	2.25	345	2.09	265	2.35	400	3.00	860	3.96	1950	3.30	1160
16, ...	....	.....	....	.....	12.7	31500	6.7	7840	4.1	2160	2.41	436	2.22	330	2.09	265	3.10	270	2.80	690	3.75	1680	3.50	1380
17, ...	....	......	....	.....	9.4	16800	6.3	6800	9.5	17200	2.45	460	2.28	360	1.97	208	3.45	1320	2.75	655	3.55	1440	3.35	1220
18, ...	....	......	....	.....	10.2	20000	5.7	5300	7.1	9000	2.41	436	2.24	340	1.99	216	3.20	1060	2.70	620	3.45	1320	3.25	1110
19, ...	....	......	....	.....	9.4	16800	5.6	5060	5.8	5550	2.35	400	2.25	345	2.04	240	3.05	910	2.65	585	3.35	1220	3.55	1440
20, ...	....	......	....	.....	9.7	18000	5.1	3960	5.1	3960	2.33	388	2.12	260	2.05	245	3.00	860	2.65	585	3.25	1110	3.90	1880
21, ...	....	......	....	.....	7.2	9300	4.7	3170	4.7	3170	2.28	360	2.10	270	2.11	275	2.90	770	2.37	412	3.25	1110	3.55	1440
22, ...	....	......	....	.....	5.8	5550	4.5	2800	4.4	2680	2.25	345	2.12	280	2.15	295	2.65	585	2.55	520	3.15	1010	3.35	1220
23, ...	....	......	....	.....	5.2	4180	4.7	3170	4.4	2630	2.19	315	2.05	245	2.33	388	2.80	690	2.55	520	3.05	910	3.05	910
24, ...	....	......	....	.....	4.9	3560	4.9	3560	4.0	2020	2.27	355	1.95	200	2.24	340	5.1	3960	2.75	655	3.05	910	3.05	910
25, ...	....	......	....	.....	4.4	2630	4.6	2980	3.7	1620	2.19	315	1.95	200	2.21	325	8.4	13200	4.2	2310	3.25	1110	3.15	1010
26, ...	....	......	...	.....	4.0	2020	4.4	2630	3.5	1380	2.15	295	1.95	200	2.22	330	6.5	7800	4.6	2980	3.45	1820	3.00	860
27, ...	....	....	6.7	7840	3.95	1950	4.1	2160	3.3	1160	2.11	275	1.93	192	2.31	376	5.6	5060	4.1	2160	3.50	1380	3.00	860
28, ...	....	.....	6.2	6550	5.0	3760	4.0	2020	3.2	1060	2.10	270	2.00	220	2.77	669	5.0	3760	3.7	1620	3.50	1880	2.85	730
29, ...	....	......	4.6	2980	11.8	27000	4.0	2020	3.15	1010	2.07	255	1.98	212	2.65	585	4.5	2800	3.45	1320	3.40	1270	2.70	620
30, ...	....	......	....	.....	14.9	44500	9.1	15600	4.0	2020	2.06	245	1.93	192	2.25	345	5.2	4180	3.31	1170	3.30	1160	2.90	770
31, ...	....	......	....	.....	10.0	19200	....	......	4.4	2630	....	......	1.93	192	2.29	365	....	......	3.15	1010	....	......	3.30	1160

Note.—January 5-February 26, inclusive, river frozen. See "Estimated Monthly Discharge" sheet for estimate during this period.

ESTIMATED MONTHLY DISCHARGE OF CHEMUNG RIVER AT CHEMUNG, N. Y.

(Drainage area, 2,440 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	700	0.287	0.330
February,	....	....	1500	0.615	0.660
March,	44500	860	8150	3.340	3.850
April,	25500	2020	8930	3.660	4.080
May,	17200	1010	3830	1.570	1.810
June,	2470	245	701	0.287	0.320
July,	478	188	272	0.111	0.130
August,	669	184	287	0.118	0.140
September,	13200	270	2200	0.901	1.000
October,	2980	412	1300	0.533	0.610
November,	5800	655	1680	0.689	0.770
December,	6800	620	2090	0.858	0.990
The year,	....	....	2640	1.080	14.690

Note.—River frozen Jan. 5—Feb. 26 inclusive. Discharge estimated from one discharge measurement under ice cover, and climatological records.

WYALUSING CREEK.

DESCRIPTION OF BASIN.

Wyalusing creek, a tributary of the North Branch of the Susquehanna river, in Susquehanna and Bradford counties, drains approximately 215 square miles. Rising in three branches, the headwaters of which spread over the central and western parts of Susquehanna county, and join near Rushland near the Susquehanna-Bradford county line, it follows a general southwesterly course to its mouth at Wyalusing, Bradford county, a distance of approximately 30 miles. The basin is sparsely populated, the habitations being scattered over the agricultural section and in small villages, the watershed consisting of hilly, farming country, containing little timber except on the hilltops. The principal tributaries are the North, Middle and East Branches, which form its headwaters, and include a number of lakes in their watersheds. This creek lies entirely within the glacial area, the slope being gradual throughout most of its course. Wyalusing creek is used to a limited extent for power purposes.

The mean annual precipitation over this watershed is from 35 to 40 inches.

The discharge of this stream has been measured since October 28, 1908, at Wyalusing, 2½ miles above the mouth.

SUSQUEHANNA BASIN—STATION NO. 4.

WYALUSING CREEK AT WYALUSING.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on October 28, 1908, at a single span, steel, through-truss, highway bridge, about 2½ miles above the mouth.

The channel is straight for 1,000 feet above and below the station. The right bank is high and not subject to overflow, while the left bank is low and water passes around the bridge at high stages. There is an abandoned head race to the left of the bridge through which water passes above gage height 2.9 feet. The bed of the stream is rocky and permanent.

Discharge measurements are taken from the downstream side of the bridge, and by wading at a section 600 feet below during low water. The initial point for soundings is top edge of east abutment, downstream side.

A standard chain gage is fastened to the bottom chord on the downstream side of the bridge. The length of chain from the bottom of weight to center of marker is 16.80 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a projection on the second stone in the bottom course of the face of the upstream wing of the left abutment, one foot from the first vertical joint of the abutment; elevation 5.512 feet above zero of gage. The gage is read once daily by Alton S. Taylor.

There are several mills on the stream above the bridge.

Since the establishment of this station, 29 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WYALUSING CREEK, AT WYALUSING, BRADFORD COUNTY, PA.

(Drainage area, 214 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
29	1918 March 18	Reckord & Knight, ..	116	202	2.06	1.65	416	0.6 measurement.

DISCHARGE TABLE FOR WYALUSING CREEK, AT WYALUSING, BRADFORD COUNTY, FROM DEC. 1, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.10	2	.30	204	.50	928	.70	2024	.50	5060
.20	4	.40	242	.60	1012	.80	2122	7.00	5700
.30	9	.50	284	.70	1098	.90	2220	.50	6360
.40	16	.60	328	.80	1186	4.00	2318	8.00	7100
.50	25	.70	376	.90	1276	.10	2415	.50	7900
.60	36	.80	428	3.00	1366	.20	2515	9.00	8700
.70	50	.90	485	.10	1456	.30	2615	10.00	10300
.80	66	2.00	550	.20	1550	.40	2715	11.00	11900
.90	86	.10	620	.30	1644	.50	2815		
1.00	112	.20	692	.40	1738	5.00	3335		
.10	140	.30	768	.50	1832	.50	3880		
.20	170	.40	846	.60	1926	6.00	4460		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WYALUSING CREEK AT WYALUSING, BRADFORD COUNTY, PA.

DAY.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
1912	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	1.19	167	1.22	177	......	180	3.45	1780	2.80	1190	0.79	64	0.33	11	0.26	7	0.67	46	1.70	376	1.06	129	1.18	164
2, ...	1.20	170	1.24	184	......	180	3.35	1690	2.20	692	0.70	50	0.35	12	0.22	5	5.30	3660	1.73	392	1.30	204	1.19	167
3, ...	1.23	180	1.19	167	......	180	4.45	2760	1.82	439	0.70	50	0.28	8	0.18	4	2.68	1080	1.45	276	1.10	140	3.78	2100
4, ...	1.25	187	1.22	177	......	180	2.72	1170	1.58	319	0.69	49	0.27	8	0.30	9	2.89	1270	1.37	231	1.02	118	2.53	953
5, ...	1.24	184	1.20	170	......	180	2.30	768	1.40	242	0.66	44	0.38	15	0.27	8	2.52	945	1.28	197	0.97	104	2.15	656
6, ...	1.12	146	1.19	167	......	310	2.34	799	1.37	231	0.61	37	0.37	14	0.18	4	4.60	2920	1.15	155	0.91	89	2.37	823
7, ...	*1.24	184	1.21	173	......	310	2.23	715	1.35	223	0.69	49	0.38	15	0.22	5	2.51	986	1.06	134	0.93	94	2.27	745
8, ...	1.17	161	1.20	170	......	310	2.98	1350	1.84	451	0.65	43	0.31	10	0.24	6	1.84	451	1.00	112	4.60	2920	1.90	485
9, ...	1.17	161	1.20	170	......	310	2.24	722	1.99	544	0.60	36	0.30	9	0.22	5	1.50	284	0.94	96	2.66	1080	1.70	376
10, ...	1.20	170	1.19	167	......	310	2.05	585	1.70	376	0.61	37	0.28	8	0.25	6	1.27	194	0.95	99	2.12	684	1.43	255
11, ...	1.22	177	1.20	170	......	1650	1.75	402	1.40	242	0.54	29	0.26	7	1.40	242	1.50	284	1.04	123	1.92	498	1.40	242
12, ...	1.12	146	1.19	167	......	1650	1.70	376	1.26	190	0.50	25	0.30	9	0.79	64	1.40	242	0.99	109	1.65	352	1.37	231
13, ...	1.10	140	1.19	167	......	1650	1.84	451	3.05	1410	0.49	24	0.33	11	0.70	50	1.15	155	1.05	126	1.51	288	0.96	102
14, ...	1.15	155	1.21	173	......	1660	1.68	366	2.08	606	0.50	25	0.23	6	0.56	32	1.02	118	0.95	99	1.90	485	1.17	161
15, ...	1.20	170	1.23	180	......	1650	1.53	297	1.78	418	0.49	24	0.24	6	0.60	36	0.98	94	0.91	89	1.49	280	1.09	137
16, ...	1.17	161	1.24	184	‡3.95	2270	4.07	2390	1.57	315	0.48	23	0.29	8	0.55	30	1.45	263	0.81	68	1.36	227	1.08	134
17, ...	1.21	173	1.26	190	2.38	830	3.32	1660	2.34	799	0.49	24	0.39	15	0.48	23	1.15	155	0.80	66	1.25	187	1.09	137
18, ...	1.21	173	1.34	219	2.48	912	4.11	2420	2.10	620	0.49	24		8	0.57	33	0.98	107	0.78	63	1.21	173	1.04	123
19, ...	1.29	201	1.37	231	2.18	678	3.27	1620	1.70	376	0.46	21	0.50	25	1.17	161	1.40	242	0.74	56	1.18	164	1.50	234
20, ...	1.30	204	1.59	324	2.53	953	2.44	879	1.53	297	0.44	20	0.41	17	0.88	82	1.60	328	0.94	96	1.14	152	1.84	451
21, ...	1.40	242	2.92	1290	1.79	423	2.05	585	1.37	231	0.47	22	0.38	15	0.74	56	1.83	212	0.83	73	1.06	134	1.48	276
22, ...	1.33	215	†	290	1.57	315	1.83	445	1.23	180	0.44	20	0.34	12	0.86	78	1.19	167	0.72	53	1.02	118	1.32	212
23, ...	1.28	197	....	290	1.78	418	2.23	715	1.15	155	0.41	17	0.33	11	1.00	112	1.12	146	0.72	53	1.01	115	1.07	132
24, ...	1.30	204	....	290	1.48	276	1.72	386	1.08	134	0.41	17	0.31	10	1.10	140	2.48	912	1.18	164	1.03	120	1.13	149
25, ...	1.24	184	....	290	1.27	194	1.82	439	1.01	115	0.45	20	0.33	11	0.84	74	5.26	3620	2.40	846	1.44	259	1.65	126
26, ...	1.20	170	....	400	1.05	126	1.50	284	0.90	86	0.41	17	0.37	14	0.74	56	3.27	1620	1.80	28	1.48	276	0.89	84
27, ...	1.21	173	....	400	1.26	190	1.54	302	0.85	76	0.33	11	0.16	3	1.74	397	2.60	1010	1.54	302	1.47	271	1.18	164
28, ...	1.18	164	....	400	1.84	451	1.38	234	0.78	63	0.37	14	0.21	4	1.10	140	2.15	656	1.38	234	1.38	234	1.08	134
29, ...	1.23	180	....	400	5.09	3430	1.39	238	0.75	58	0.33	11	0.28	8	0.90	86	1.80	428	1.33	212	1.20	170	0.95	99
30, ...	1.22	177	....	......	3.82	2140	3.95	2270	0.98	94	0.32	10	0.23	6	0.79	64	2.20	692	1.22	177	1.27	194	1.08	131
31, ...	1.24	184	....	......	3.68	2000	....	......	0.90	86	....	......	0.31	10	0.70	50	....	......	1.18	149	....	......	1.70	376

*Creek frozen. †Ice moved and jammed at bridge. ‡Ice went out. Dec. 25-28 inclusive, slush ice. Discharge Feb. 22-Mar. 15 inclusive estimated from Lackawanna River at Scranton.

ESTIMATED MONTHLY DISCHARGE OF WYALUSING CREEK, AT WYALUSING, BRADFORD COUNTY.

(Drainage area, 214 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	243	140	177	0.827	0.953
February,	....	....	268	1.252	1.350
March,	....	....	849	3.967	4.573
April,	2760	234	970	4.533	5.057
May,	1410	58	363	1.696	1.955
June,	64	10	29	.136	.152
July,	25	3	11	.051	.059
August,	397	4	67	.313	.361
September,	3660	46	775	3.621	4.040
October,	846	53	182	.850	.980
November,	2920	89	340	1.589	1.773
December,	2100	84	342	1.598	1.843
The year,	....	....	364	1.708	23.096

Note.—Discharge Feb. 22-Mar. 15 inclusive, estimated from Lackawanna river at Scranton.

LACKAWANNA RIVER.

DESCRIPTION OF BASIN.

Lackawanna river, one of the major tributaries of the North Branch of the Susquehanna river in northwestern Pennsylvania, drains an area of approximately 345 square miles in Susquehanna, Wayne, Lackawanna and Luzerne counties, on the west slope of the Delaware-Susquehanna Divide. Rising in numerous lakes in two branches, one on either side of the central part of the Wayne-Susquehanna county line, which join a short distance below Union Dale, Susquehanna county, it follows a southerly course through Susquehanna and Wayne counties and thence flows southwest through Lackawanna county to its mouth above Pittston, Luzerne county, a distance of approximately 50 miles. The upper section of this stream, to Forest City, Susquehanna county, flows through a rolling, farming country, sparsely populated and largely deforested. From this point the valley widens to approximately six miles in width, bounded on one side by Bald Mountain, and on the other by Moosic Mountain, partly covered with second growth timber, the stream flowing through a thickly populated coal mining territory.

The stream is exceedingly rapid, falling from the junction of the two branches (elevation 1,590) at Stillwater, to Olyphant, a distance of 23 miles, at the rate of 36 feet per mile; from Olyphant, through Scranton to Moosic, a distance of 12 miles, at the rate of 10 feet per mile; and from Moosic to its mouth (elevation 526), a distance of four miles, at the rate of 27 feet per mile. It lies entirely within the glacial area. There are many tributaries, the largest of which are Spring and Roaring Brooks. Scranton, the third largest city in Pennsylvania, and many boroughs, are located in this basin. On account of the presence of mine washings, the main stream is not used for water supply purposes, although most of its tributaries are extensively employed. The dry weather flow is maintained above the natural flow of other streams in this section by the drainage of mine water into the stream.

The mean annual precipitation over this watershed is from 35 to 40 inches.

The discharge of this stream has been measured since July 1, 1908, at Scranton, about eight miles above the mouth.

SUSQUEHANNA BASIN—STATION NO. 5.

LACKAWANNA RIVER AT SCRANTON.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 1, 1908, at a single span, steel, through truss, highway bridge at Carbon Street, Scranton, and was discontinued September 16, 1911, until February 2, 1912, on which date it was re-established at the same point.

Just above the bridge there is a sharp curve to the right, while below the station the channel is nearly straight for 1,000 feet. The current passes under the bridge at a 25 degree angle to the right, and is practically normal under the water pipe bridge, except at high stages. The water pipe bridge is located about 10 feet downstream from the highway bridge. Both banks are high and not subject to overflow; there being a good ashlar abutment on either side of the bridge. The bed of the stream is of mud and loose stones, together with a large amount of culm, and probably shifts considerably; while the waters of the river are polluted with mine wastes.

Discharge measurements are made from the downstream side of the Carbon Street Bridge; the downstream girder of the water pipe bridge, just below, and by wading at a section several hundred feet upstream. The initial point for soundings on the Carbon Street Bridge is right end of downstream hand-rail; on the water pipe bridge, initial point is right end of downstream girder.

A standard chain gage is attached to the Carbon Street Bridge. The length of chain, from the bottom of the weight to the marker is 20.83 feet. The elevation of zero is 676.577 feet, Sandy Hook datum of the D. L. & W. Railroad. Bench Mark No. 1 is on the spout of a fire plug on the south corner of Carbon Street and Love Road, elevation 691.987 feet. Bench Mark No. 2 is on a stone projection on top of eighth course from top under left hand downstream corner of Carbon Street Bridge, elevation, 682.801 feet.

This station is maintained in co-operation with the City Engineer's office of Scranton, the gage being read twice daily, except Sunday, by an employee of that office.

Since the establishment of this section 17 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

Owing to the uncertainty of gage heights during 1912, only the discharge measurements and rating table have been published.

DISCHARGE MEASUREMENTS OF LACKAWANNA RIVER, AT SCRANTON, LACKAWANNA COUNTY, PA.

(Drainage area 175 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
17	1913 March 19	Reckord & Knight,	88	209	2.59	3.12	541	From Carbon St. bridge 0.6 msmt.

DISCHARGE TABLE FOR LACKAWANNA RIVER, AT SCRANTON, LACKAWANNA COUNTY, FROM JANUARY 1st, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.00	60	.50	380	4.00	1120	.50	2040	7.00	3145
.10	66	.60	422	.10	1175	.60	2110	.10	3225
.20	73	.70	466	.20	1230	.70	2180	.20	3305
.30	81	.80	610	.30	1290	.80	2250	.30	3385
.40	91	.90	556	.40	1350	.90	2320	.40	3470
.50	105	3.00	604	.50	1410	6.00	2390	.50	3555
.60	120	.10	652	.60	1470	.10	2460	.60	3640
.70	137	.20	700	.70	1530	.20	2535	.70	3725
.80	155	.30	750	.80	1590	.30	2610	.80	3810
.90	178	.40	800	.90	1650	.40	2685	.90	3895
2.00	205	.50	850	5.00	1715	.50	2760	8.00	3980
.10	235	.60	900	.10	1780	.60	2835		
.20	267	.70	955	.20	1845	.70	2910		
.30	302	.80	1010	.30	1910	.80	2985		
.40	340	.90	1065	.40	1975	.90	3065		

Note.—This rating table is only applicable subsequent to Jan. 1, 1912, and is based on two discharge measurements made during 1912 and 1913, together with former curve.

SUSQUEHANNA BASIN—STATION NO. 6.

NORTH BRANCH OF SUSQUEHANNA RIVER AT WILKES-BARRE.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey in co-operation with the United States Weather Bureau, on March 30th, 1899, at the Market Street Bridge, Wilkes-Barre.

The channel is straight for one-quarter mile above and below the station. The left bank is high and above ordinary floods, while the right bank is low and overflows at approximately 20 feet gage height. The bed consists of sand and gravel and is somewhat shifting.

Discharge measurements are taken from the upstream side of the bridge, which has a total span of 700 feet between abutments. The initial point for soundings is east end of upstream hand-rail.

In 1888 readings were commenced by the U. S. Weather Bureau on a staff gage attached to the easternmost pier. During low stages of the river, however, the water receded from the pier, and, therefore, on March 30th, 1899, a standard chain gage superceded the staff. The datum of the chain gage was four feet below the zero of the staff gage, thus eliminating the minus readings of the gage. Soon after the installation of the chain gage by the Geological Survey, the Weather Bureau adopted the same, taking readings once daily. The standard length of chain from the bottom of weight to the marker was 40.68 feet. Bench Mark No. 1 is extreme west end of stone door-sill of north entrance to Coal Exchange Building, elevation, 32.99 feet above zero of gage. Bench Mark No. 2 is top of rail in front of Lehigh Valley Depot, elevation, 39.70 feet above gage datum, and 545 feet above mean sea level. Bench Mark No. 3 is top of stone monument at Northampton and River Streets, elevation, 30.70 feet above zero of gage and 536 feet above mean sea level. The elevation of zero of gage is 505.3 feet above mean sea level.

On July 20, 1910, the U. S. Weather Bureau installed a Mott gage to replace the chain gage, referred to the datum of the previous gage, or Bench Mark No. 3, the standard length of tape being 40.67 feet, which gage has been operated since that date.

On account of the inaccuracy of gage heights from 1888 to 1899, due to a confusion in the elevation of the gage datum, no data has been published for this period.

Since the establishment of this station 35 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF N. BR. SUSQUEHANNA RIVER, AT WILKES-BARRE, LUZERNE COUNTY, PA.

(Drainage area 9,995 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
35	1913 March 19	Reckord & Knight, .	653	7362	3.80	9.42	27953	Surface msmt.

DISCHARGE TABLE FOR NORTH BR. SUSQUEHANNA RIVER AT WILKES-BARRE, LUZERNE COUNTY, FROM JANUARY 1st, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.90	820	.30	12560	.70	33020	.10	56340	.50	91070
2.00	845	.40	13000	.80	33520	.20	56980	.60	91990
.10	895	.50	13440	.90	34020	.30	57620	.70	92910
.20	970	.60	13880	11.00	34520	.40	58260	.80	93830
.30	1055	.70	14320	.10	35020	.50	58920	.90	94760
.40	1155	.80	14760	.20	35520	.60	59600	20.00	95700
.50	1270	.90	15200	.30	36020	.70	60280	.10	96660
.60	1395	7.00	15640	.40	36520	.80	60960	.20	97690
.70	1530	.10	16080	.50	37020	.90	61680	.30	98780
.80	1680	.20	16520	.60	37520	16.00	62400	.40	99920
.90	1840	.30	16970	.70	38020	.10	63120	.50	101110
3.00	2005	.40	17420	.80	38520	.20	63850	.60	102300
.10	2185	.50	17870	.90	39020	.30	64590	.70	103540
.20	2380	.60	18320	12.00	39520	.40	65340	.80	104830
.30	2590	.70	18770	.10	40020	.50	66100	.90	106180
.40	2810	.80	19220	.20	40520	.60	66860	21.00	107600
.50	3035	.90	19670	.30	41020	.70	67630	.10	109030
.60	3265	8.00	20120	.40	41520	.80	68410	.20	110480
.70	3500	.10	20590	.50	42020	.90	69200	.30	111950
.80	3750	.20	21060	.60	42520	17.00	70000	.40	113440
.90	4000	.30	21530	.70	43040	.10	70800	.50	114950
4.00	4250	.40	22000	.80	43560	.20	71600	.60	116460
.10	4510	.50	22470	.90	44080	.30	72400	.70	117990
.20	4780	.60	22940	13.00	44600	.40	73200	.80	119540
.30	5070	.70	23410	.10	45120	.50	74000	.90	121110
.40	5380	.80	23880	.20	45640	.60	74800	22.00	122700
.50	5710	.90	24350	.30	46160	.70	75600	.10	124280
.60	6050	9.00	24820	.40	46680	.80	76400	.20	125860
.70	6400	.10	25290	.50	47200	.90	77200	.30	127440
.80	6750	.20	25760	.60	47720	18.00	78000	.40	129030
.90	7100	.30	26230	.70	48240	.10	78810	.50	130600
5.00	7450	.40	26700	.80	48760	.20	79630	.60	132180
.10	7800	.50	27170	.90	49280	.30	80460	.70	133760
.20	8160	.60	27640	14.00	49820	.40	81300	.80	135340
.30	8540	.70	28110	.10	50380	.50	82150	.90	136920
.40	8930	.80	28580	.20	50940	.60	83000	23.00	138500
.50	9320	.90	29050	.30	51500	.70	83860	24.00	154250
.60	9710	10.00	29520	.40	52080	.80	84730	25.00	170000
.70	10100	.10	30020	.50	52660	.90	85610	26.00	186000
.80	10500	.20	30520	.60	53240	19.00	86500	27.00	201500
.90	10900	.30	31020	.70	53840	.10	87400	28.00	217300
6.00	11300	.40	31520	.80	54440	.20	88310	29.00	233000
.10	11710	.50	32020	.90	55060	.30	89230	.50	240850
.20	12120	.60	32520	15.00	55700	.40	90150	30.00	248700

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on two discharge measurements made during 1912-13, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF NORTH BR. SUSQUEHANNA RIVER AT WILKES-BARRE, LUZERNE COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G. H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	5.74	10300	....	6000	7.24	16700	17.94	77500	13.74	48400	5.34	8700	2.54	1320	2.13	918	3.13	2240	7.53	18000	5.63	9830	5.43	9050
2, ...	5.44	9090	...	6000	6.64	14100	18.74	84700	11.04	31700	5.14	7940	2.54	1320	2.13	918	3.43	2880	7.03	15800	5.43	9050	5.33	8660
3, ...	5.54	9480	....	6000	5.74	10800	22.24	126000	9.14	25500	4.74	6540	2.44	1200	2.23	996	10.03	29700	6.63	14000	5.23	8270	8.53	22600
4, ...	5.14	7940	....	6000	5.24	8310	20.54	102000	7.94	19800	4.44	5510	2.44	1200	2.23	996	7.83	19400	6.33	12800	5.13	7910	11.83	38700
5, ...	5.04	7590	....	6000	4.94	7240	16.14	63400	7.14	16300	5.14	7940	2.54	1320	2.23	996	6.33	12700	5.73	10200	5.03	7560	11.73	38200
6, ...	....	7000	....	5500	5.54	9480	13.54	47400	6.64	14100	4.84	6890	2.54	1320	2.23	996	6.63	14000	5.23	8270	4.83	6860	10.33	31200
7, ...	....	7000	....	5500	6.64	14100	15.24	57200	6.34	12700	4.44	5510	2.44	1200	2.23	996	6.53	13600	5.03	7560	4.73	6500	10.43	31700
8, ...	....	7000	....	5500	5.24	8310	16.84	64900	6.44	13200	4.24	4900	2.44	1200	2.23	996	5.13	7910	4.63	6160	7.73	18900	10.73	33200
9, ...	....	7000	....	5500	5.24	8310	17.44	73500	7.34	17200	4.04	4350	2.44	1200	2.23	996	4.63	6160	4.43	5480	11.23	35700	9.53	27800
10, ...	....	7000	....	5500	5.34	8700	15.54	59200	7.94	19800	3.94	4100	2.44	1200	2.23	996	4.03	4330	4.23	4870	11.13	35200	8.33	21700
11, ...	....	6500	....	5500	6.44	13200	13.24	45800	7.44	17600	3.74	3600	2.44	1200	2.33	1080	3.73	3580	4.13	4590	9.63	27800	7.83	17100
12, ...	....	6500	....	5500	5.94	11100	11.44	36700	6.84	14900	3.54	3130	2.44	1200	2.90	1840	3.63	3340	4.03	4330	8.43	22100	6.63	14000
13, ...	....	6500	....	5500	7.74	19000	10.84	33700	6.54	13600	3.34	2680	2.34	1100	2.83	1730	3.83	3830	4.53	5810	7.63	18500	6.03	11400
14, ...	....	6500	....	5500	6.74	14500	11.54	37200	7.24	16700	3.34	2680	2.34	1100	2.83	1730	3.63	3340	4.53	5810	7.03	15800	5.93	11000
15, ...	....	6500	....	5500	6.74	14500	10.54	32200	7.14	16300	3.24	2460	2.54	1320	2.90	1840	3.43	2880	4.43	5480	6.73	14500	5.33	8660
16, ...	....	6500	....	6000	14.64	53500	10.94	34200	6.44	13200	3.14	2260	2.54	1320	2.83	1730	3.43	2880	4.33	5160	6.63	14000	5.13	7910
17, ...	....	6500	....	6000	16.74	67900	12.94	44300	7.14	16300	3.14	2260	2.54	1320	2.73	1580	3.33	2660	4.23	4870	6.33	12700	5.23	8270
18, ...	....	6500	....	6000	15.64	59900	12.74	43200	11.44	36700	3.04	2080	2.44	1200	2.73	1580	3.93	4080	4.03	4330	6.03	11400	5.13	7910
19, ...	....	6500	....	6000	17.64	75100	12.74	43200	9.44	26900	3.04	2080	2.44	1200	2.73	1580	4.03	4330	3.93	4080	5.73	10200	5.23	8270
20, ...	....	6500	....	6000	15.84	61300	12.04	39700	8.44	22200	2.94	1910	2.54	1320	2.73	1580	4.43	5480	3.73	3580	5.53	9440	6.43	13100
21, ...	....	6000	....	7500	16.44	65600	11.04	34700	7.34	17200	2.84	1740	2.54	1320	2.73	1580	4.33	5160	3.73	3580	5.33	8660	7.53	18000
22, ...	....	6000	....	7500	13.94	49500	9.44	26900	6.54	13600	2.94	1910	2.54	1320	2.63	1440	4.23	4870	3.63	3340	5.23	8270	7.23	16700
23, ...	....	6000	....	7500	10.94	34200	8.94	24600	6.04	11500	2.84	1740	2.44	1200	2.63	1440	4.13	4590	3.83	3820	5.23	8270	6.43	13100
24, ...	....	6000	....	7500	9.74	28300	8.74	23600	5.84	10700	2.84	1740	2.34	1100	2.83	1730	4.43	5480	4.23	4870	5.23	8270	5.83	10600
25, ...	...	6000	....	7500	9.04	25000	9.24	25900	5.44	9090	2.74	1590	2.24	1000	3.33	2660	14.93	55300	5.83	10600	5.23	8270	5.43	9050
26, ...	....	6000	7.24	16700	8.14	20800	8.64	23100	5.14	7940	2.74	1590	2.24	1000	3.53	3100	14.33	51700	8.73	23600	5.43	9050	5.03	7560
27, ...	....	6000	7.84	19400	7.74	19000	8.14	20800	4.94	7240	2.74	1590	2.24	1000	3.23	2440	11.03	34700	9.13	25400	5.63	9830	5.23	8270
28, ...	....	6000	9.44	26900	7.74	19000	7.34	17200	4.64	6190	2.64	1450	2.24	1000	4.03	4330	9.63	27800	8.23	21200	5.83	10600	5.03	7560
29, ...	....	6000	8.24	21200	11.34	36200	6.94	15400	4.34	5190	2.64	1450	2.24	1000	3.53	3100	8.33	21700	7.13	16200	5.83	10600	4.93	7200
30, ...	....	6000	....	.....	20.01	96100	10.04	29700	4.24	4900	2.54	1320	2.24	1000	3.33	2660	7.53	18000	6.43	13100	5.63	9830	4.83	6860
31, ...	....	6000	....	......	21.74	119000	......	....	4.14	4620	....	......	2.14	925	3.13	2240	......	....	5.93	11000	.....	......	5.63	9830

Note.—River frozen Jan. 6-Feb. 25, inclusive, daily discharge estimated from Lackawanna River at Scranton, Delaware River at Port Jervis, and climatological records.

ESTIMATED MONTHLY DISCHARGE OF NORTH BR. SUSQUEHANNA RIVER AT WILKES-BARRE, LUZERNE COUNTY.

(Drainage Area 9,995 Square Miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	6790	0.679	0.783
February,	....	....	8160	0.816	0.880
March,	119000	7240	32500	3.252	3.749
April,	126000	15400	46200	4.622	5.157
May,	48400	4620	16600	1.661	1.915
June,	8700	1320	3450	0.345	0.384
July,	1320	925	1180	0.118	0.136
August,	4330	918	1700	0.170	0.196
September,	55300	2240	12600	1.261	1.407
October,	25400	3340	9270	0.927	1.069
November,	35700	6500	13100	1.311	1.463
December,	38700	6860	15600	1.561	1.800
The year,	....	....	13900	1.394	18.989

Note.—River frozen Jan. 6-Feb. [illegible], inclusive, daily discharge estimated from Lackawanna River at Scranton, Delaware River at Port Jervis and climatological records.

SUSQUEHANNA BASIN—STATION NO. 7.

NORTH BRANCH OF SUSQUEHANNA BASIN AT DANVILLE.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on March 25th, 1899, at Mill Street Bridge, near Pennsylvania Railroad Station, at South Danville, 52 miles below Wilkes-Barre, and about 11 miles above the junction of the North Branch with the West Branch of the Susquehanna river, at Northumberland. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania, and has since been maintained and operated by this Commission.

The channel is straight for one-half mile above and below the station. The right bank is liable to overflow in extreme freshets, while the left bank is high and does not overflow. The bed of the river is permanent, consisting of rocks and gravel.

Discharge measurements are taken from the downstream side of the bridge; the initial point for soundings being the downstream corner of the right abutment, Danville side.

On March 25th, 1899, a standard chain gage was attached to the bridge, but on March 9th, 1904, the bridge and gage were carried away in an ice freshet and, from that date until March 24th, 1905, observations were made from temporary gages and were constantly liable to error. On March 24th, 1905, a new chain gage was attached to the upstream hand-rail of the new bridge in the first span from the right bank. On July 8th, 1905, the gage was moved and attached in the same position on the downstream side of the bridge. In both positions it was referred to the datum of former gages. The length of chain from the bottom of weight to the marker is 44.63 feet; the elevation of zero being arbitrary datum. Bench Mark No. 1 is on the extreme south end of the stone door-sill at the east entrance to the City Filtration Plant, elevation, 31.70 feet above zero of gage. Bench Mark No. 2 is a point on the face of the first course of the right abutment, located three inches from the top of course, and 2.65 feet from the downstream side, elevation, 14.05 feet above gage datum.

During the period January 1, 1904, to March 22, 1905, the daily gage heights and discharge have not been published, due to the inaccuracy of the gage heights obtained from the temporary gages which were in operation through most of this period.

Since the establishment of this station 31 discharge measurements have been made. No discharge measurements have been made since the 1910-11 report of the Water Supply Commission. The data prior to 1912 will be found in the above mentioned report.

DISCHARGE TABLE FOR NORTH BR. SUSQUEHANNA RIVER AT DANVILLE, MONTOUR COUNTY, FROM JAN. 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.60	790	.50	15340	.40	40770	.30	77580	.20	124380
.70	920	.60	15860	.50	41610	.40	78640	.30	125780
.80	1070	.70	16390	.60	42450	.50	79700	.40	127200
.90	1240	.80	16920	.70	43300	.60	80780	.50	128620
2.00	1420	.90	17460	.80	44160	.70	81860	.60	130060
.10	1620	6.00	18000	.90	45030	.80	82940	.70	131500
.20	1830	.10	18540	10.00	45900	.90	84020	.80	132960
.30	2060	.20	19090	.10	46770	14.00	85120	.90	134420
.40	2300	.30	19640	.20	47650	.10	86220	18.00	135900
.50	2560	.40	20200	.30	48530	.20	87320	.10	137380
.60	2840	.50	20770	.40	49420	.30	88440	.20	138880
.70	3140	.60	21340	.50	50310	.40	89560	.30	140380
.80	3460	.70	21920	.60	51200	.50	90680	.40	141880
.90	3780	.80	22510	.70	52090	.60	91820	.50	143400
3.00	4120	.90	23100	.80	52990	.70	92960	.60	144920
.10	4480	7.00	23.00	.90	53890	.80	94100	.70	146440
.20	4840	.10	24310	11.00	54800	.90	95260	.80	147980
.30	5220	.20	24930	.10	55720	15.00	96420	.90	149520
.40	5600	.30	25550	.20	56650	.10	97580	19.00	151060
.50	6000	.40	26180	.30	57590	.20	98760	.10	152620
.60	6400	.50	26820	.40	58530	.30	99940	.20	154180
.70	6800	.60	27460	.50	59480	.40	101140	.30	155740
.80	7220	.70	28110	.60	60430	.50	102340	.40	157320
.90	7660	.80	28770	.70	61390	.60	103560	.50	158900
4.00	8100	.90	29430	.80	62360	.70	104780	.60	160480
.10	8550	8.00	30100	.90	63340	.80	106020	.70	162080
.20	9000	.10	30780	12.00	64320	.90	107260	.80	163680
.30	9460	.20	31470	.10	65300	16.00	108520	.90	165280
.40	9920	.30	32180	.20	66280	.10	109780	20.00	166880
.50	10390	.40	32900	.30	67280	.20	111060	.10	168500
.60	10860	.50	33630	.40	68280	.30	112340	.20	170120
.70	11340	.60	34380	.50	69280	.40	113640	.30	171740
.80	11820	.70	35140	.60	70300	.50	114940	.40	173360
.90	12310	.80	35910	.70	71320	.60	116260	.50	175000
5.00	12800	.90	36700	.80	72340	.70	117580	.60	176640
.10	13300	9.00	37500	.90	73380	.80	118920	.70	178280
.20	13800	.10	38310	13.00	74420	.90	120260	.80	179920
.30	14310	.20	39120	.10	75460	17.00	121620	.90	181580
.40	14820	.30	39940	.20	76520	.10	123000	21.00	183240

Note—The above table is that of the U. S. G. S., and has been adopted by the Water Supply Commission for 1912.

DAIL SCHARGES OF NORTH BR. SUSQUEHANNA RIVER AT DANVILLE, MONTOUR COUNTY, PA.

1912.	RIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G. H.	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	9	101000	c10.91	54000	3.86	7480	2.39	2280	2.09	1600	2.88	3720	6.44	20400	4.92	12400	4.79	11800
2, ...	3	97800	10.07	46500	4.62	11000	2.39	2280	2.09	1600	2.83	3560	6.22	19200	4.82	11900	4.77	11700
3, ...	2	12[illegible]000	8.34	32500	4.35	9690	2.35	2180	2.10	1620	5.23	14000	5.78	16800	4.72	11400	6.32	19800
4, ...	9	126000	7.19	24900	4.10	8550	2.29	2040	2.12	1660	7.80	28800	5.48	15200	4.49	10800	9.02	37700
5, ...	1	83000	6.54	21000	3.96	7920	2.44	2400	2.10	1620	5.86	17200	5.10	13800	4.39	9870	10.47	50000
6, ...	7	58200	5.99	17900	4.31	9510	2.47	2480	2.10	1620	5.08	13000	4.78	11700	4.39	9870	9.57	42200
7, ...	9	55600	5.79	16900	4.10	8550	2.41	2330	2.09	1600	5.63	16000	4.48	10100	5.12	13400	9.47	41400
8, ...	59	70200	5.91	17500	3.88	7570	2.31	2080	2.10	1620	5.18	13700	4.23	9140	5.97	17800	9.37	40500
9, ...	39	81800	6.51	20800	3.70	6800	2.29	2040	2.09	1600	4.50	10400	3.93	7790	8.42	33000	8.57	34200
10, ...	37	73100	7.09	24200	3.52	6080	2.35	2180	2.17	1770	3.72	7180	3.86	7480	10.12	46900	7.49	26800
11, ...	.17	56400	6.84	22700	3.42	5680	2.39	2280	2.51	2590	3.48	5920	3.88	7570	9.12	38500	6.57	21200
12, ...	.87	44800	6.39	20100	3.25	5090	2.34	2160	2.57	2760	3.36	5220	3.78	7140	7.59	27400	5.97	17800
13, ...	.07	38100	6.44	20400	3.12	4550	2.34	2160	2.79	3430	3.22	4920	3.68	6720	6.75	22200	5.62	16000
14, ...	.99	37400	6.59	21300	3.06	4840	2.30	2060	2.80	3460	3.28	5070	3.98	8010	6.25	19400	5.25	14100
15, ...	.97	37300	6.71	22000	3.00	4120	2.47	2480	2.76	3330	3.18	4770	3.88	7570	5.92	17600	5.07	13200
16, ...	.94	37000	6.24	19300	2.96	3980	2.43	2380	2.83	3560	3.18	4770	3.76	7050	5.71	16400	4.87	12200
17, ...	.64	51600	6.59	21300	2.96	3980	2.39	2280	2.71	3170	3.08	4410	3.74	6970	5.57	15700	4.51	10400
18, ...	0.94	54300	8.35	32500	2.90	3780	2.37	2280	2.69	3110	3.26	5070	3.66	6640	5.32	14400	4.72	11400
19, ..	.74	52400	8.99	37400	2.87	3680	2.33	2180	3.10	4480	4.08	8460	3.54	6160	5.04	13000	5.32	14100
20, ..	0.48	50100	7.67	27900	2.82	3520	2.29	2040	3.34	5370	3.98	7790	3.46	5840	4.82	11900	5.72	16500
21, ..	9.24	39400	6.79	22500	2.80	3460	2.29	2040	3.14	4620	4.09	8500	3.37	5490	4.65	11100	5.75	16700
22, ..	8.79	35800	6.00	18000	2.72	3200	2.31	2080	2.94	3920	4.08	8240	3.33	5330	4.28	9870	5.47	15200
23, ..	7.99	30000	5.48	15200	2.68	3080	2.29	2040	2.61	2870	4.46	10200	3.34	5370	4.41	9970	5.87	17800
24, ..	7.64	27100	5.20	13800	2.66	3020	2.27	1990	2.63	2930	3.93	7790	3.68	6720	4.50	10400	5.42	14900
25, ..	7.84	29000	4.95	12600	2.63	2930	2.22	1880	2.74	3270	9.18	33000	4.78	11700	4.59	10800	4.89	12800
26, ..	7.54	27100	4.74	11500	2.58	2780	2.19	1810	2.95	3950	d12.56	69900	5.66	16200	4.71	11400	‡4.77	11700
27, ..	6.84	22700	4.45	10200	2.54	2670	2.17	1770	3.17	4730	10.28	48400	8.08	30600	4.82	11900	4.71	11400
28, ..	6.19	19000	4.22	9090	2.50	2560	2.15	1720	3.09	4410	8.70	35100	7.30	25600	4.89	12300	‡4.68	11200
29, ..	6.14	18800	3.94	7840	2.49	2530	2.10	1620	3.37	5490	7.88	29300	6.40	20200	4.99	12800	4.49	10800
30, ..	7.27	25400	3.85	7440	2.44	2400	2.09	1600	3.17	4730	6.76	22300	5.78	16500	4.92	12400	4.52	10500
31, ..	......	....	3.72	6880	....	......	2.14	1700	2.99	4090	......	......	5.28	14200	......	......	4.97	12700

*Ri arge estimated from N. Br. Susquehanna River at Wilkes-Barre. †Ice broke at 2 a. m. ‡Slush ice. a Max.
12.20 5:00 p. m.; 18500 sec. ft. c Max. 11.29 at 5:00 p. m.; 57500 sec. ft. d Max. 12.98 at 7.00 a. m.; 78700 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF NORTH BR. SUSQUEHANNA RIVER AT DANVILLE, MONTOUR COUNTY.

(Drainage Area 11,255 Square Miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	7800	0.693	0.799
February,	66300	....	10800	0.960	1.035
March,	12900	7140	38500	3.421	3.944
April,	185000	18800	53600	4.762	5.313
May,	57500	6880	21200	1.884	2.172
June,	11000	2400	5150	0.458	0.511
July,	2480	1600	2090	0.186	0.215
August,	5490	1600	3120	0.277	0.319
September,	73700	8560	15400	1.368	1.527
October,	30600	5330	11600	1.031	1.188
November,	46900	9870	16200	1.439	1.606
December,	50000	10800	19600	1.741	2.007
The year,	....	....	17100	1.518	20.636

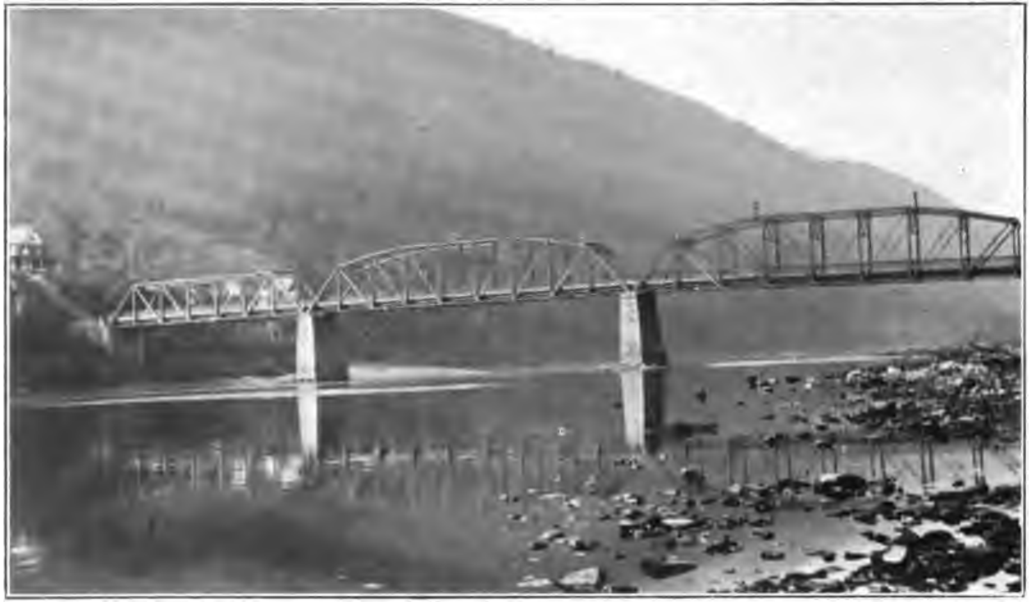
Note.—River frozen Jan. 6-Feb. 26 inclusive, and daily discharges estimated from N. Br. Susquehanna River at Wilkes-Barre.

WEST BRANCH OF SUSQUEHANNA RIVER.

DESCRIPTION OF BASIN.

The West Branch of the Susquehanna river, which joins the North Branch at Northumberland, to form the main Susquehanna river, drains a total area of approximately 6,980 square miles, lying entirely within the state. This branch rises in the west central part of the state, in the northwestern corner of Cambria county, and flows northward a short distance and then turning in a general northeasterly direction, continues to below Renovo, Clinton county, where it takes an easterly course to the mouth of Loyalsock creek, and thence turns southward to its junction with the North Branch at Northumberland. The total length of this stream, from its headwaters to its mouth is about 226 miles. The West Branch of the Susquehanna river is unique among Pennsylvania rivers, in that it has numerous large tributaries, several of which have basins of 1,000 square miles and over, all of which join the river above Williamsport, which is 41 miles above the mouth.

The headwaters in Cambria and Clearfield counties lie in a rich, bituminous coal mining area, the country being thickly settled and dotted with boroughs and villages. Some farming is carried on in this area, and the mountains are partly covered with second growth timber. From Clearfield to Lock Haven the basin is sparsely settled,



Gaging Station on West Branch Susquehanna River at Renovo.

little farming being carried on, and the country in general is rough and rugged, the hills being well covered with second growth timber. From Lock Haven to the mouth the drainage basin is well settled along the main stream, and most of the tributaries. Considerable farming is carried on in the valleys, but the mountains are rugged and covered with second growth.

The entire drainage basin is mountainous and rugged, and the river from its headwaters follows a winding course, through a narrow channel, hemmed in by the hills and mountains, parallel to and west of the Backbone Ridge of the Allegheny Mountains, cutting through the mountains as it turns southward at Halls. The slope of the headwaters is steep, the river often falling at the rate of eight feet per mile, to Keating, but from this point the slope becomes less steep, falling to the mouth at an average rate of two and one-half feet per mile. Only a small section of the northeastern corner of this basin lies within the glacial area. Extensive limestone areas underlie some of the tributaries which lie to the south of the main stream, and in the Allegheny Mountains.

The principal tributaries are Clearfield, Moshannon, Sinnemahoning, Kettle, Bald Eagle, Pine, Lycoming and Loyalsock creeks.

The principal towns in the basin are Williamsport and Lock Haven cities, and many large boroughs and farming and mining villages.

Many domestic water supplies are obtained from the tributaries of the stream, but only a few from the parent stream.

The northern portion of the basin is subject to a mean annual precipitation of 35 to 40 inches, and the southern part from 40 to 45 inches.

The discharge is measured at Renovo and Williamsport, the stations having been established October 1, 1905, and March 1, 1895, respectively.

SUSQUEHANNA BASIN—STATION NO. 8.

WEST BRANCH OF SUSQUEHANNA RIVER AT RENOVO.

DESCRIPTION OF STATION.

This station was established by the United States Weather Bureau on September 1st, 1905, and is located on the Eighth Street Bridge, Renovo.

The channel is straight for 100 feet above and 3,000 feet below the station. Both banks are high and not subject to overflow. The bed is rocky and permanent.

Discharge measurements are taken from the downstream side of the bridge and by wading at a section 2,000 feet above the bridge, at the foot of Third Street. The initial point for soundings is the end of hand-rail left downstream side. A standard chain gage is fastened to the upstream hand-rail near the north pier, the length of chain from the bottom of weight to the marker being 41.06 feet. The elevation of zero is 637.4 feet above mean sea level. Bench Mark No. 1 is southwest corner of north abutment of bridge, chiselled in stone face ten feet above low water mark, established from P. R. R. gage on north pier; elevation, 647.4 feet above mean sea level or 10 feet above zero of gage. Bench Mark No. 2 is a one inch offset in the upstream corner of the north concrete abutment, one foot above the bottom, with the corner above the projection chiselled out; elevation, 645.44 feet above mean sea level or 8.04 feet above zero of gage. Bench Mark No. 3 is a chiselled rod seat on a projection in the eleventh course down from the bridge seat on the southwest end of the stonework of the north abutment, six inches below a chiselled arrow head; elevation, 648.17 feet above mean sea level, or 10.77 feet above zero of gage.

The gage is read once daily by H. L. Baird.

Gage heights were read on the P. R. R. gage, which was painted on the upstream side of the north pier, by voluntary observers, from July 1st, 1895, to December 31st, 1903. These gage heights are not considered reliable and have, therefore, not been published. From January 1st, 1904, to September 1st, 1905, no readings were taken at this station. From this latter date the readings were taken by the U. S. Weather Bureau observer, but, on account of the unreliability of the gage heights, to January 1st, 1908, due to an error in chain length, no data is published prior to 1908. Since September, 1908, the Water Supply Commission has obtained 20 discharge measurements, from which a satisfactory rating table has been derived.

The following gage heights have been furnished by the U. S. Weather Bureau. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WEST BR. SUSQUEHANNA RIVER AT RENOVO, CLINTON COUNTY, PA.

(Drainage Area 2,990 Square Miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
14	March 5	Boehringer & Batley,	412	2616	1.80	2.55	4,719	0.6 measurement.
15	March 26	Batley, ...	460	5483	6.26	8.65	34,323	Surface msmt.
16	March 26	Batley, ...	460	5934	7.19	9.79	42,690	Surface msmt.
17	March 27	Batley, ...	460	6999	8.77	11.85	61,401	Combination meter and float.
18	March 27	Batley, ...	460	7279	9.42	12.60	68,579	Surface msmt.

DISCHARGE TABLE FOR WEST BR. SUSQUEHANNA RIVER AT RENOVO, CLINTON COUNTY, FROM JANUARY 1, 1908

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
—1.10	80	.80	3230	.70	11670	.60	26850	.50	47750
—1.00	100	.90	3420	.80	12060	.70	27500	.60	48600
—0.90	125	2.00	3620	.90	12460	.80	28150	.70	49500
—0.80	155	.10	3820	5.00	12860	.90	28800	.80	50400
—0.70	190	.20	4020	.10	13260	8.00	29450	.90	51300
—0.60	230	.30	4240	.20	13660	.10	30100	11.00	52250
—0.50	280	.40	4460	.30	14100	.20	30750	.10	53200
—0.40	340	.50	4690	.40	14550	.30	31400	.20	54150
—0.30	400	.60	4930	.50	15000	.40	32100	.30	55100
—0.20	470	.70	5180	.60	15500	.50	32800	.40	56050
—0.10	540	.80	5440	.70	16000	.60	33500	.50	57000
—0.00	620	.90	5710	.80	16500	.70	34200	.60	58000
.10	700	3.00	5980	.90	17000	.80	34900	.70	59000
.20	790	.10	6260	6.00	17500	.90	35600	.80	60000
.30	890	.20	6540	.10	18000	9.00	36300	.90	61000
.40	1000	.30	6840	.20	18550	.10	37000	12.00	62000
.50	1120	.40	7140	.30	19100	.20	37700	.10	63000
.60	1250	.50	7440	.40	19660	.30	38450	.20	64100
.70	1390	.60	7760	.50	20225	.40	39200	.30	65200
.80	1530	.70	8080	.60	20800	.50	39950	.40	66300
.90	1680	.80	8400	.70	21400	.60	40700	.50	67400
1.00	1830	.90	8740	.80	22000	.70	41450	.60	68600
.10	1990	4.00	9080	.90	22600	.80	42200	.70	69800
.20	2150	.10	9420	7.00	23200	.90	42950	.80	71000
.30	2320	.20	9780	.10	23800	10.00	43700	.90	72200
.40	2490	.30	10140	.20	24400	.10	44450	13.00	73400
.50	2670	.40	10520	.30	25000	.20	45250		
.60	2850	.50	10900	.40	25600	.30	46050		
.70	3040	.60	11280	.50	26200	.40	46900		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WEST BR. SUSQUEHANNA RIVER AT RENOVO, CLINTON COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis
1,	*2.8	5440	....	2000	*3.45	7290	7.95	29200	7.35	25300	1.34	2390	.64	1310	.64	1310	1.64	2930	3.0	5980	2.5	4690	2.1	3820
2,	*2.7	5180	....	2000	*3.0	5960	8.25	31100	5.95	17200	1.04	1890	.54	1170	.64	1310	2.84	5550	2.7	5180	2.5	4690	2.1	3820
3,	*2.9	5710	....	2000	*2.55	4810	11.35	55600	4.95	12700	.94	1740	.54	1170	.74	1450	4.24	9920	2.0	3620	2.3	4240	3.7	8080
4,	*2.9	5710	....	2000	*2.6	4930	10.35	46500	4.15	9600	.74	1450	.44	1050	.54	1170	7.04	23400	1.4	2490	2.0	3620	1.9	3420
5,	*2.8	5440	....	2000	*2.05	3720	10.00	43700	3.65	7920	.74	1450	.44	1050	.44	1050	6.04	17700	1.4	2490	1.8	3230	2.3	4240
6,	†	3000	....	2000	*1.85	3320	5.95	17200	3.35	6990	.74	1450	.54	1170	.44	1050	4.04	9220	1.4	2490	1.6	2850	2.7	5180
7,	....	3000	....	2000	1.60	2850	4.95	12700	3.85	8570	.64	1310	.54	1170	.44	1050	3.54	7570	1.4	2490	1.5	2670	3.2	6540
8,	....	3000	....	2000	1.85	3320	5.95	17200	3.95	8910	.64	1310	.44	1050	.34	934	3.04	6090	1.0	1880	3.0	5980	3.3	6840
9,	....	3000	....	2000	2.30	4240	5.45	14800	4.45	10700	.54	1170	.44	1050	.34	934	2.30	4240	1.0	1880	3.2	6540	3.0	5980
10,	....	3000	....	2000	2.25	4130	4.80	12100	4.25	9960	.44	1050	.44	1050	.34	934	1.80	3230	1.1	1990	3.0	5980	2.8	5440
11,	....	3000	....	2000	2.75	5310	4.15	9600	3.75	8240	.34	934	.34	934	.44	1050	1.60	2850	1.8	3230	3.0	5980	2.9	5710
12,	....	3000	....	2000	2.80	5440	3.75	8240	3.55	7600	.24	830	.54	1170	.64	1310	1.30	2320	1.6	2850	3.0	5980	2.9	5710
13,	....	3000	....	2000	2.55	4810	3.55	7600	3.35	6990	.14	736	.64	1310	1.04	1890	1.10	1990	1.6	2850	3.0	5980	*2.6	4930
14,	....	3000	....	2000	2.40	4460	3.35	6990	3.45	7290	.04	652	.54	1170	1.54	2740	1.00	1880	1.7	3040	3.0	5980	*3.7	8080
15,	....	3000	....	2000	2.45	4580	3.20	6540	3.25	6690	.04	652	.54	1170	1.34	2390	0.80	1580	1.8	3230	3.0	5980	3.8	8400
16,	....	3000	....	2000	8.95	36000	3.45	7290	2.95	5840	.04	652	.44	1050	1.04	1890	1.60	1880	1.6	2850	2.4	4460	2.0	3620
17,	....	3000	....	2000	8.00	29400	3.75	8240	8.75	34600	.14	736	.64	1310	.84	1590	1.70	3040	1.5	2670	2.4	4460	1.8	3230
18,	....	3000	....	2000	7.25	24700	3.75	8240	7.75	27800	.24	830	1.04	1890	1.04	1890	1.50	2670	1.4	2490	2.2	4020	1.7	3040
19,	....	3000	....	2000	8.70	34200	3.75	8240	6.15	18300	.24	830	1.04	1890	1.34	2390	1.20	2150	1.0	1880	2.2	4020	1.8	3230
20,	....	3000	....	2000	8.85	35200	4.00	9080	4.95	12700	.24	830	1.54	2740	2.04	3700	1.60	1880	1.3	2320	2.2	4020	1.7	3040
21,	....	3000	....	2700	7.95	29200	3.45	7290	4.35	10300	.24	830	1.54	2740	1.64	2930	1.00	1880	1.5	2670	2.2	4020	1.7	3040
22,	....	3000	....	2700	7.60	26800	2.95	5840	3.75	8240	.34	934	1.64	2930	1.44	2560	1.00	1880	1.6	2850	2.2	4020	1.7	3040
23,	....	3000	....	2700	6.15	18300	2.95	5840	3.25	6690	.34	934	1.44	2560	1.34	2390	1.00	1880	2.5	4690	2.2	4020	1.7	3040
24,	....	3000	....	2700	5.20	13700	2.75	5310	2.75	5310	.54	1170	2.54	4790	1.04	1890	1.60	2850	3.0	5980	2.4	4460	1.7	3040
25,	....	3000	....	2700	4.95	12700	2.80	5440	2.34	4330	.64	1310	2.64	5030	.84	1590	2.90	5710	3.5	7440	2.2	4020	1.2	2150
26,	....	3000	....	2700	4.95	12700	2.45	4580	2.14	3900	.64	1310	2.04	3700	.64	1310	4.10	9420	4.6	11300	2.2	4020	0.7	1390
27,	....	3000	a7.5	26200	4.80	12100	2.15	3920	1.74	3120	.54	1170	1.64	2930	.64	1310	3.50	7440	4.8	12100	2.2	4020	0.6	1250
28,	....	3000	6.0	17500	4.95	12700	1.95	3520	1.54	2740	.54	1170	1.34	2390	.84	1590	3.10	6360	4.2	9780	2.2	4020	†	1250
29,	....	3000	4.7	11700	7.00	23200	1.95	3520	1.44	2560	.54	1170	1.04	1890	1.24	2220	3.00	5980	3.8	8400	2.2	4020	†	1250
30,	....	3000	....	......	10.75	50000	5.00	12900	1.44	2560	.54	1170	.84	1590	1.44	2560	3.40	7140	3.5	7440	2.1	3820	†	1250
31,	....	3000	....	......	8.90	35600	......	......	1.44	2560	....	......	.64	1310	1.04	1890	....	......	3.0	5980	....	......	*2.2	4020

*Slush ice. †Frozen. Discharge Jan. 6 to Feb. 26, and Dec. 28-30, inclusive, estimated from climatological records. aMax. 10.2; 45200 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF WEST BR. SUSQUEHANNA RIVER AT RENOVO, CLINTON COUNTY.

(Drainage Area 2.990 Square Miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	3400	1.137	1.311
February,	45200	....	3850	1.288	1.389
March,	60000	2850	15300	5.117	5.899
April,	55600	3520	13900	4.649	5.187
May,	34600	2560	9880	3.304	3.809
June,	2390	652	1140	0.381	0.425
July,	5030	934	1860	0.622	0.717
August,	3700	934	1750	0.585	0.674
September,	23400	1580	5410	1.809	2.018
October,	12100	1880	4400	1.472	1.697
November,	6540	2670	4530	1.515	1.690
December,	8400	1250	4070	1.361	1.569
The year,	....	....	5790	1.937	26.385

Note.—Discharge Jan. 6-Feb. 26, and Dec. 28-30 inc., estimated from climatological records.

BALD EAGLE CREEK.

DESCRIPTION OF BASIN.

Bald Eagle creek, a large tributary of the West Branch of the Susquehanna river in Centre and Clinton counties, drains an area of approximately 780 square miles. Rising on the southern boundary in the western part of Centre county, it flows northeasterly through an agricultural valley, the adjacent hills being covered with second growth timber. The valley gradually widens to a considerable breadth as the stream enters Clinton county, continuing to its mouth at Lock Haven, the total length being about 50 miles, and the watershed oval in shape. The valleys in this basin are extensively farmed and contain numerous boroughs and villages, while the bordering ridges are nearly all covered with heavy second growth timber. This creek rises at an elevation of approximately 1,110 feet and, in a distance of about 23 miles to Milesburg, falls at the rate of 18 feet per mile; from this point to the mouth the fall is approximately five feet per mile. The principal tributaries are Fishing, Beech and Spring creeks. Spring and Fishing creeks enter from the south, draining a limestone section, and their well maintained dry weather flow aids largely in making the discharge of Bald Eagle creek, in such seasons, a most important affluent of the West Branch. Many of the smaller tributaries are used for domestic water supply, nearly all the boroughs and larger villages being so equipped.

The mean annual precipitation over the greater portion of the watershed is from 40 to 45 inches.

The Water Supply Commission of Pennsylvania maintains three gaging stations in this basin; at Beech Creek station; at Milesburg; and on Spring creek near Bellefonte. A gaging station at Castanea, one mile above the mouth, was formerly operated by this Commission, but, on account of being influenced by backwater from the West Branch of the Susquehanna river during medium and high stages, was discontinued.

SUSQUEHANNA BASIN—STATION NO. 9.

BALD EAGLE CREEK AT MILESBURG.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on February 6th, 1911, at the Pennsylvania Railroad Bridge No. 53, over Bald Eagle creek, at Milesburg, 300 yards above the mouth of Spring creek.

The channel above the station is almost straight for 300 feet, while below the station there is a slight bend toward the northwest for about 500 feet. The right bank is high, steep, and rocky; the left bank is low, but the railroad embankment prevents flood water going around the bridge. The flood channel under the bridge is 115.5 feet wide, abutment to abutment. The bed of the creek consists of gravel and stones and is fairly permanent.

Discharge measurements are taken from the downstream side of the railroad bridge; the initial point for soundings being the face of the left abutment under downstream guard-rail along the tracks.

A ten foot staff gage is attached to the downstream side of the pier, facing to the left. The elevation of zero is arbitrary datum. Bench Mark No. 1 is cross "X" on top of fourth step from top of left downstream wing-wall, 1.7 feet in from end of step, elevation, 6.655 feet above gage datum. The gage is read twice daily by P. H. Haupt.

Since the establishment of this station nine discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BALD EAGLE CREEK AT MILESBURG, CENTRE COUNTY, PA.

(Drainage Area 140 Square Miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
5	Jan. 9	Langenheim, ...	98	374	3.32	3.16	1243	Surface measurement.
6	Jan. 9	Langenheim, ...	95	331	2.52	2.80	843	Surface measurement.
7	Jan. 10	Langenheim, ...	91	280	1.82	2.25	509	Surface measurement.
8	March 6	Boehringer & Batley,	83	190	0.73	1.20	138	Surface measurement.
9	March 28	Batley, ...	104	378	2.96	3.08	1118	Surface measurement.

DISCHARGE TABLE FOR BALD EAGLE CREEK AT MILESBURG, CENTRE COUNTY, FROM FEB. 6, 1911.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.00	....	.10	105	.20	470	.30	1340	.40	2900
.10	1	.20	125	.30	525	.40	1460	.50	3060
.20	3	.30	145	.40	580	.50	1590	.60	3220
.30	6	.40	170	.50	640	.60	1720	.70	3390
.40	13	.50	195	.60	700	.70	1850	.80	3560
.50	21	.60	225	.70	770	.80	1990	.90	3780
.60	31	.70	260	.80	840	.90	2130	5.00	3900
.70	43	.80	295	.90	920	4.00	2280		
.80	57	.90	335	3.00	1010	.10	2430		
.90	71	2.00	375	.10	1110	.20	2580		
1.00	87	.10	420	.20	1220	.30	2740		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF BALD EAGLE CREEK AT MILESBURG, CENTRE COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.
1,	1.46	185	....	90	......	200	2.75	805	3.02	1080	0.75	50	0.27	5	0.26	5	0.44	16	1.12	109	0.94	77	0.72	46
2,	1.40	170	....	90	......	200	2.85	880	2.36	558	0.72	46	0.25	4	0.25	4	0.74	49	0.98	84	0.98	84	0.70	43
3,	1.32	150	....	90	......	200	2.88	904	1.98	367	0.68	41	0.25	4	0.24	4	1.10	105	0.86	65	0.82	60	1.04	94
4,	1.26	137	....	90	......	200	2.36	558	1.74	274	0.64	36	0.25	4	0.20	3	0.88	68	0.78	54	0.76	51	1.09	108
5,	*	135	....	90	......	200	2.11	425	1.58	219	0.60	31	0.23	4	0.20	3	0.64	36	0.72	46	0.72	46	1.10	105
6,	....	135	....	85	......	130	1.88	327	1.58	219	0.58	29	0.23	4	0.20	3	0.52	23	0.64	36	0.66	38	2.05	393
7,	....	135	....	85	......	130	1.85	305	1.78	288	0.58	29	0.20	3	0.18	3	0.45	17	0.61	32	f2.33	569	1.95	355
8,	....	135	....	85	......	130	1.95	355	2.36	558	0.52	23	0.20	3	0.15	2	0.38	12	0.56	27	2.75	805	1.59	222
9,	....	135	....	85	......	130	1.75	278	2.18	460	0.46	18	0.20	3	0.18	3	0.34	9	0.52	23	2.06	402	1.38	165
10,	....	135	....	85	......	130	1.58	219	1.91	339	0.45	17	0.20	3	0.29	6	0.28	5	0.66	38	1.76	281	1.30	145
11,	....	130	....	80	......	130	1.42	175	1.72	267	0.42	15	0.20	3	0.45	17	0.25	4	0.95	79	1.50	196	1.18	121
12,	....	130	....	80	......	140	1.38	165	1.65	242	0.37	11	0.20	3	0.51	22	0.23	4	0.76	51	1.36	160	1.08	101
13,	....	130	....	80	......	140	1.50	195	1.94	351	0.36	10	0.20	3	0.36	10	0.23	4	0.56	27	1.31	148	1.05	96
14,	....	130	....	80	......	140	1.46	185	1.62	232	0.35	10	0.20	3	0.35	10	0.22	4	0.52	23	1.40	170	1.05	96
15,	....	130	....	80	a5.55	g4850	1.95	355	1.52	201	0.35	10	0.20	3	0.32	7	0.22	4	0.46	18	1.16	117	1.05	96
16,	....	120	....	90	3.82	2020	1.95	355	c3.52	1620	0.72	46	0.20	3	0.26	5	0.49	20	0.44	16	0.99	85	1.05	96
17,	....	120	....	90	3.48	1560	1.82	303	3.68	1820	1.14	113	0.26	5	0.22	4	0.36	10	0.43	15	1.00	87	1.05	96
18,	....	120	....	90	3.18	1200	b3.78	1960	2.70	770	0.69	42	0.25	4	0.20	3	0.28	5	0.40	13	0.96	81	1.08	92
19,	....	120	....	90	3.25	1280	2.88	904	2.20	470	0.50	21	0.28	5	0.20	3	0.31	7	0.62	33	0.89	70	1.04	94
20,	....	120	....	90	3.52	1620	2.25	498	1.90	335	0.42	15	0.28	5	0.24	4	0.41	14	0.70	43	0.88	68	1.00	87
21,	....	110	....	110	3.10	1110	1.89	331	1.74	274	0.35	10	0.48	19	0.31	7	0.26	5	0.54	25	0.84	63	1.00	87
22,	....	110	....	110	2.52	652	1.70	260	1.59	222	0.45	17	0.80	57	0.35	10	0.25	4	0.48	19	0.80	57	1.00	87
23,	....	110	....	110	2.12	430	1.90	335	1.46	185	0.40	13	0.58	29	0.33	8	0.46	18	e1.62	232	0.76	51	0.97	82
24,	....	110	....	110	2.85	880	1.78	288	1.31	148	0.37	11	0.48	19	0.30	6	d2.54	664	1.49	192	0.82	60	0.94	77
25,	....	110	....	110	2.60	700	1.72	267	1.14	113	0.36	10	0.46	18	0.26	5	2.32	356	1.45	182	0.85	64	0.90	71
26,	....	100	....	460	2.52	652	1.52	201	1.08	101	0.35	10	0.46	13	0.23	4	1.90	335	1.51	198	0.78	54	0.86	65
27,	....	100	....	460	2.68	756	1.56	213	0.96	81	0.33	8	0.32	7	0.23	4	1.71	264	1.29	143	0.74	49	0.84	68
28,	....	100	....	460	3.15	1160	1.42	175	0.93	76	0.33	8	0.28	5	0.24	4	1.22	129	1.16	117	0.72	46	0.80	57
29,	....	100	....	460	4.50	3060	2.50	640	0.91	77	0.32	7	0.26	5	0.38	12	1.48	190	1.05	96	0.74	49	0.82	60
30,	....	100	...	......	3.65	1780	3.62	1750	0.92	74	0.30	6	0.22	4	0.28	5	1.38	165	1.00	87	0.73	47	0.90	71
31,	....	100	....	......	3.08	1090	......	....	0.85	64	....	....	0.25	4	0.25	4	......	....	0.96	81	......	....	0.75	50

aMax. 6.00′ at 4 p. m.; g57000 sec. ft. bMax. 4.10′ 8 a. m.; 2430 sec. ft. cMax. 4.90′ at 4 p. m.; 3730 sec. ft. dMax. 3.40′ at 4 p. m.; 1460 sec. ft. eMax. 2.25′ at 4 p. m.; 498 sec. ft. fMax. 3.65′ at 4 p. m.: 1780 sec. ft. gEstimated. *Creek frozen over. Discharge Jan. 5 to March 14 inclusive, estimated from climatological records.

ESTIMATED MONTHLY DISCHARGE OF BALD EAGLE CREEK, AT MILESBURG, CENTRE COUNTY, PA.

(Drainage area 140 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	124	0.886	1.022
February,	....	....	142	1.014	1.093
March,	5700	....	871	6.221	7.172
April,	2430	165	487	3.479	3.882
May,	3730	64	388	2.771	3.195
June,	113	6	24	0.171	0.191
July,	57	3	8	0.057	0.066
August,	22	2	6	0.043	0.050
September,	1460	4	102	0.729	0.813
October,	498	13	71	0.507	0.584
November,	1780	38	138	0.986	1.100
December,	398	43	110	0.786	0.906
The year,	....	....	206	1,471	20.074

Jan. 5 to March 14, inclusive, creek frozen; discharge estimated from climatological records.

SPRING CREEK.

DESCRIPTION OF BASIN.

Spring creek, an important tributary of Bald Eagle creek, drains an area of approximately 145 square miles, rising in the south central part of Centre county and flowing in a general northerly direction through a rich and thickly inhabited farming section, to its mouth at Milesburg, a distance of about 20 miles, the basin being approximately pear shaped. Its course is winding, the slope being rapid at the headwaters and gradually decreasing as the mouth is reached. There are many small tributaries rising in the well timbered mountains, but throughout a stretch of ten miles of this stream, from above State College to Bellefonte, no surface tributaries enter it. Throughout this section the valley and surrounding hills are underlain with limestone, sink holes being much in evidence, and the drainage of this part of the watershed appears in numerous limestone springs close to the creek banks, the largest of which is Bellefonte Spring at Bellefonte, with a continuous flow of approximately 9,000,000 gallons daily. The dry weather flow of this creek is very large, and plays an important part in maintaining the low water flow of Bald Eagle creek. In this watershed lie State College, Bellefonte and Centre Hall boroughs, and many large farming villages, nearly all of which towns obtain domestic water supply from the upper tributaries of Spring creek, while the main stream is used at numerous points by small water power installations.

The watershed lies partly in an area 35 to 40 inches and partly in an area of 40 to 45 inches mean annual precipitation.

The discharge of this stream has been measured since February 7, 1911, about one mile below Bellefonte.

SUSQUEHANNA BASIN—STATION NO. 10.

SPRING CREEK AT BELLEFONTE.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on February 7, 1911, on a through truss, iron, highway bridge, one mile below Bellefonte.

The channel is straight for 300 feet above the station, but there is a bend to the left 80 feet below. The bed of the creek is of gravel and stone, and is fairly permanent. Both banks are flat and overflow during high water.

Discharge measurements are taken from the downstream side of the highway bridge; the initial point for soundings being the face of the left abutment on the downstream side of the bridge, under the guard-rail.

A staff gage is bolted to the downstream face of the left abutment of the highway bridge. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a chiselled mark on downstream corner of downstream edge of left abutment; elevation, 7.56 feet above gage datum. The gage is read twice daily by J. H. Oliger.

There is a canal about 300 feet east of the creek proper, which carries a very small part of the flow of the stream, most of which is leakage through the head gates. Discharge measurements made from the concrete bridge over the canal indicate that the mean daily discharge is approximately six cubic feet per second during the entire year, which has, therefore, been added to the daily discharge.

Since the establishment of this station seven discharge measurements have been made of the creek proper and the canal.

The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

Gaging Station on Spring Creek, near Bellefonte.

DISCHARGE MEASUREMENTS OF SPRING CREEK NEAR BELLEFONTE, CENTRE COUNTY, PA.

(Drainage area 145 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
5	Jan. 9	Langenheim, ...	88	202	2.55	2.50	516	Creek proper. Surface msmt.
	Jan. 9	Langenheim, ...	9	10	0.75	1.82	7.2	Canal. Sur. msmt.
6	March 6	Boehringer and Batley	88	128	1.76	1.74	225	Creek proper. Surface msmt.
	March 6	Boehringer and Batley	25	14	0.33	1.00	4.6	Canal. Sur. msmt.
7	March 28	Batley, ...	88	269	3.58	3.82	963	Creek proper. Surface msmt.
	March 28	Batley, ...	25	16.8	0.35	1.10	5.8	Canal. Sur. msmt.

DISCHARGE TABLE FOR SPRING CREEK, NEAR BELLEFONTE, CENTRE COUNTY, FROM FEB. 7, 1911

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.00	87	.70	215	.40	445	.10	800	.80	1380
.10	101	.80	240	.50	485	.20	870	.90	1480
.20	116	.90	270	.60	530	.30	940	4.00	1590
.30	132	2.00	300	.70	575	.40	1010		
.40	150	.10	335	.80	625	.50	1090		
.50	170	.20	370	.90	680	.60	1180		
.60	192	.30	405	3.00	740	.70	1280		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SPRING CREEK, NEAR BELLEFONTE, CENTRE COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	2.09	338	1.71	224	1.98	300	2.82	642	2.44	467	1.96	294	1.68	216	1.64	208	1.60	198	1.62	203	1.61	200	1.62	203
2, ...	2.05	324	1.71	224	1.90	276	2.92	698	2.40	451	1.94	288	1.65	210	1.64	208	1.60	198	1.58	194	1.62	203	1.66	212
3, ...	2.03	313	1.65	210	1.84	258	2.92	698	2.34	427	1.96	294	1.65	210	1.63	205	1.64	208	1.60	198	1.55	187	1.67	214
4, ...	1.95	291	1.66	212	1.82	252	2.75	606	2.26	397	1.90	276	1.65	210	1.63	205	1.62	203	1.60	198	1.56	189	1.68	216
5, ...	1.84	258	1.64	208	1.82	252	2.64	554	2.22	383	1.91	279	1.64	208	1.63	205	1.64	208	1.58	194	1.57	191	1.69	219
6, ...	1.82	252	1.64	208	1.77	239	2.52	500	2.28	404	1.92	282	1.64	208	1.64	208	1.61	200	1.56	189	1.59	196	1.72	226
7, ...	1.92	282	1.65	210	1.78	241	2.51	496	2.40	451	1.91	279	1.68	216	1.60	198	1.61	200	1.59	196	2.08	334	1.71	224
8, ...	1.82	252	1.71	224	2.30	411	2.45	471	2.60	536	1.86	264	1.72	226	1.62	203	1.60	198	1.59	196	2.10	341	1.61	200
9, ...	1.80	246	1.65	210	2.75	606	2.38	443	2.65	558	1.84	258	1.70	221	1.62	203	1.60	198	1.56	189	2.02	313	1.62	203
10, ...	1.82	252	1.58	194	2.30	411	2.30	411	2.58	527	1.86	264	1.88	270	1.70	221	1.60	198	1.60	198	1.86	264	1.62	203
11, ...	1.82	252	1.66	212	2.10	341	2.25	394	2.50	491	1.79	244	1.65	210	1.69	219	1.60	198	1.61	200	1.82	252	1.63	205
12, ...	1.76	236	1.59	196	2.02	313	2.25	394	2.46	475	1.84	258	1.62	203	1.72	226	1.60	198	1.57	191	1.78	241	1.61	200
13, ...	1.73	228	1.64	208	2.29	408	2.24	390	2.54	509	1.76	236	1.60	198	1.69	219	1.60	198	1.56	189	1.88	270	1.59	196
14, ...	1.78	241	1.65	210	2.12	348	2.16	362	2.36	435	1.75	234	1.60	198	1.65	210	1.60	198	1.56	189	1.84	258	1.62	203
15, ...	1.81	249	1.68	216	b5.75	e3980	2.12	348	2.34	427	1.78	241	1.64	208	1.62	203	1.59	196	1.55	187	1.76	236	1.58	194
16, ...	1.75	234	1.66	212	3.12	820	2.11	344	2.64	554	1.84	258	1.71	224	1.63	205	1.64	208	1.56	189	1.82	252	1.62	203
17, ...	1.85	261	1.76	236	2.62	545	2.10	341	2.56	518	1.86	264	1.64	208	1.61	200	1.64	208	1.60	198	1.70	221	1.54	185
18, ...	1.85	261	1.65	210	2.58	527	2.44	467	2.46	475	1.79	244	1.64	208	1.60	198	1.60	198	1.59	196	1.70	221	1.62	203
19, ...	1.88	270	1.75	234	2.65	558	2.35	431	2.54	509	1.75	234	1.65	210	1.60	198	1.62	203	1.61	200	1.69	219	1.68	216
20, ...	1.88	270	2.78	621	2.66	568	2.30	411	2.41	455	1.75	234	1.62	203	1.64	208	1.58	194	1.55	187	1.68	216	1.60	198
21, ...	1.80	246	2.02	313	2.60	586	2.28	404	2.38	443	1.74	231	1.74	231	1.64	208	1.58	194	1.55	187	1.78	241	1.54	185
22, ...	1.80	246	2.40	451	2.50	491	2.22	383	2.30	411	1.74	231	1.73	228	1.64	208	1.64	208	1.55	187	1.63	205	1.52	180
23, ...	1.96	294	1.88	270	2.39	447	2.24	390	2.22	383	1.75	234	1.70	221	1.61	200	1.68	216	1.56	189	1.64	208	1.61	200
24, ...	2.05	324	1.88	270	2.38	44[illegible]	2.05	324	2.20	376	1.75	234	1.68	216	1.61	200	1.90	276	1.60	198	1.66	212	1.55	187
25, ...	1.81	249	a3.05	776	2.35	43[illegible]	2.10	341	2.16	362	1.74	231	1.69	219	1.61	200	1.90	276	1.64	208	1.71	224	1.52	180
26, ...	1.80	246	2.45	483	2.52	50[illegible]	2.02	313	2.11	344	1.72	226	1.70	221	1.60	198	1.85	261	1.70	221	1.74	231	1.50	176
27, ...	1.76	236	2.70	581	2.82	64[illegible]	2.08	334	2.08	334	1.70	221	1.71	224	1.60	198	1.71	224	1.60	198	1.71	224	1.59	196
28, ...	1.75	234	2.18	369	3.30	94[illegible]	2.01	310	2.05	324	1.69	219	1.61	200	1.60	198	1.65	210	1.68	216	1.65	210	1.52	180
29, ...	1.72	226	2.06	327	3.40	10[illegible]	2.28	404	2.05	324	1.70	221	1.65	210	1.63	205	1.65	210	1.65	210	1.72	226	1.49	174
30, ...	1.74	231	......	....	3.18	8[illegible]	2.49	487	2.02	313	1.70	221	1.64	208	1.60	198	1.65	210	1.66	212	1.63	205	1.61	200
31, ...	1.72	226	......	....	2.95	7[illegible]6	......	......	1.99	303	....	......	1.64	208	1.60	198	....	......	1.68	216	....	......	1.68	216

a Max. 4.10 at 5:00 p. m.; e1700 sec. ft. b Max. 6.20 at 8:00 a. m.; e4780 sec. ft. c Estimated. 6 sec. ft. added for canal to daily discharge.

Gaging Station on Bald Eagle Creek, at Beech Creek Station, Clinton Co.

ESTIMATED MONTHLY DISCHARGE OF SPRING CREEK NEAR BELLEFONTE, CENTRE COUNTY.

(Drainage area 145 square miles).

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	338	226	260	1.793	2.067
February,	e1700	194	294	2.028	2.187
March,	e4780	239	603	4.159	4.795
April,	698	310	436	3.007	3.355
May,	558	303	431	2.972	3.426
June,	294	219	250	1.724	1.923
July,	270	198	215	1.483	1.710
August,	226	198	205	1.414	1.630
September,	276	194	210	1.448	1.616
October,	221	187	198	1.366	1.575
November,	341	187	233	1.607	1.793
December,	226	174	200	1.379	1.590
The year,	e4780	174	295	2.032	27.667

e Estimated.

SUSQUEHANNA BASIN—STATION NO. 11.

BALD EAGLE CREEK AT BEECH CREEK STATION.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on June 23rd, 1910, at the three span, pony-truss, highway bridge, immediately above Beech Creek station, on the Pennsylvania Railroad.

The channel is straight for 450 feet above the station, with Beech creek entering at right angles from the west immediately above the bridge, while the channel below the station is straight for 600 feet. The direction of the current is straight under the lower side of the bridge. The right bank is 35 feet above the bed of the creek, while on the left there are flats 8 to 10 feet above the bed. The bed of the creek is of rock, gravel and mud.

Discharge measurements are taken from the downstream side of the bridge; the initial point for soundings being the end of the wooden guard-rail on the downstream side at the east end of the bridge.

A standard chain gage is fastened to the guard-rail in the fifth panel from the east end on the upstream side of the bridge. The length of chain from the bottom of the weight to the marker is 35.37 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is chiselled on the outer downstream corner of the right bridge seat; elevation, 19.085 feet above zero of gage. The gage is read twice daily by S. C. Mains, Station Agent.

Since the establishment of this station six discharge measurements have been made. Owing to the insufficient number of discharge measurements, no rating curve has been computed for this station, and only the discharge measurements and daily gage heights have been published. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BALD EAGLE CREEK, AT BEECH CREEK STATION, CLINTON COUNTY, PA.

(Drainage area 565 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
5	March 28	Batley, ...	249	1475	4.56	6.60	6719	Surface measurement.
6	March 29	Batley, ...	225	1056	3.52	4.86	3713	Surface measurement.

DAILY MEAN GAGE HEIGHTS AND DISCHARGE OF BALD EAGLE CREEK AT BEECH CREEK, CLINTON COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	3.04	2.63	3.06	4.97	4.62	2.28	1.71	1.68	2.12	2.65	2.81	†2.58
2,	2.88	2.62	2.74	5.26	4.06	2.16	1.71	1.66	2.34	2.55	2.84	2.59
3,	2.80	2.53	2.69	c5.40	3.65	2.17	1.71	1.65	2.73	2.45	†2.78	2.56
4,	2.74	2.41	2.58	4.54	3.29	2.11	1.71	1.64	2.58	2.43	2.72	2.56
5,	2.55	2.35	2.52	4.06	3.14	2.06	1.73	1.64	2.36	2.35	2.71	2.57
6,	*2 76	2.50	2.40	3.72	3.16	2.08	1.72	1.63	2.17	2.25	2.70	h3.23
7,	2.89	2.60	2.59	3.69	3.70	2.06	1.71	1.62	2.13	2.29	g4.18	3.14
8,	2.89	2.40	2.96	3.60	3.58	2.03	1.67	1.62	2.09	2.33	4.27	†3.05
9,	2.86	2.46	3.55	3.33	3.66	1.96	1.71	1.62	2.04	2.31	3.63	2.96
10,	2.80	2.35	3.14	3.21	3.41	1.93	1.76	1.80	1.99	2.45	†3.45	2.98
11,	2.82	2.35	2.88	3.14	3.34	1.94	1.81	1.79	2.04	2.65	3.27	2.82
12,	2.75	2.38	2.90	3.06	3.48	1.94	1.74	1.82	2.06	2.57	3.07	2.78
13,	2.78	2.38	3.22	3.18	3.68	1.95	1.78	1.76	2.04	†2.59	3.01	2.91
14,	2.85	2.50	3.04	3.05	3.40	1.93	1.72	1.93	2.00	2.61	3.01	3.10
15,	2.92	2.52	b5.85	3.14	3.24	1.91	1.85	1.85	2.10	2.58	2.83	†2.94
16,	2.97	2.45	5.98	3.30	d4.42	2.44	1.73	1.88	2.44	2.57	2.79	2.78
17,	2.95	2.52	4.75	3.28	5.35	2.23	1.79	1.90	2.26	2.57	†2.75	3.01
18,	3.08	2.52	5.08	4.84	4.46	2.03	1.79	2.02	2.09	2.55	2.71	2.54
19,	3.20	2.60	5.18	4.05	3.92	1.93	1.75	2.09	2.04	2.65	2.66	2.54
20,	3.32	3.35	5.56	3.58	3.51	1.87	1.71	2.26	2.06	2.72	2.64	2.50
21,	3.20	3.42	5.06	3.35	3.28	1.85	1.73	2.33	2.04	2.68	2.60	2.42
22,	3.05	4.50	4.32	3.16	3.06	1.93	2.01	2.28	2.04	2.61	2.57	†2.36
23,	3.12	3.52	3.80	3.11	2.91	1.83	1.81	2.24	2.13	f3.01	2.55	2.31
24,	3.25	3.32	3.82	2.92	2.76	1.85	1.75	2.14	e3.88	3.14	†2.56	2.36
25,	3.00	3.18	4.12	2.86	2.66	1.84	1.73	2.12	4.18	3.13	2.57	2.26
26,	2.82	3.60	3.98	2.76	2.57	1.84	1.73	2.04	3.32	3.15	2.51	2.18
27,	2.80	a4.72	4.22	2.84	2.47	1.81	1.73	2.10	2.94	3.06	2.56	2.32
28,	2.72	3.78	4.88	2.72	2.40	1.78	1.67	2.08	2.74	2.96	2.59	2.24
29,	2.74	3.24	5.98	3.50	2.42	1.79	1.61	2.20	2.98	2.95	2.57	†2.38
30,	2.78	....	6.18	4.97	2.43	1.75	1.65	2.12	2.82	2.91	2.57	2.51
31,	2.78	....	5.20	....	2.31	....	1.66	2.09	....	2.85	....	3.00

*Creek frozen Jan. 1-March 14, inclusive. Readings taken to water surface through hole cut in ice. a Max. 5.05′ at 7:30 a. m. b Max. 7.10′ at 5:00 p. m. c Max. 5.70′ at 7:30 a. m. d Max. 5.70′ at 5:00 p. m. e Max. 4.48′ at 5:00 p. m. f Max. 3.29′ at 5:00 p. m. g Max. 5.07′ at 5:00 p. m. h Max. 3.41′ at 5:00 p. m. †Interpolated.

PINE CREEK.

DESCRIPTION OF BASIN.

Pine creek, one of the major tributaries of the West Branch of the Susquehanna river, drains an area of approximately 975 square miles in Potter, Tioga and Lycoming counties. Rising in the northeastern part of Potter county, on the divide of the Allegheny, Genesee and Susquehanna river basins, it flows in a general southeasterly directions to its mouth at Jersey Shore, Lycoming county, a distance of approximately 75 miles.

The headwaters are steep and rapid, flowing through narrow valleys to Galeton, Potter county, from which point the creek continues in a broader valley and with less fall, passing through extensive marshy areas into Tioga county, where it turns southward through a deep, narrow valley, with considerable fall, walled in on either side by high table land, through which it has cut a channel with steep, precipitous sides, nearly to its mouth, where the valley again broadens out. This stream has many tributaries, the most important being West Branch, Marsh run, Babb Creek and Little Pine creek. Practically the entire watershed is well covered with second growth timber, there being proportionately little cultivated land. The headwaters of Pine creek lie within the glacial area. There are numerous small villages in its basin, and a few boroughs of considerable size, some of which obtain their water supply therefrom.

The upper part of the watershed is subject to a mean annual precipitation of 35 to 40 inches, while the lower part lies in an area of from 40 to 45 inches.

The discharge has been measured since July 15, 1908, at Waterville, 13½ miles above the mouth.

SUSQUEHANNA BASIN—STATION NO. 12.

PINE CREEK AT WATERVILLE.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 15, 1908, at a single span, through truss, highway bridge, three-quarters of a mile above the railroad station at Waterville.

The channel is straight for 1,000 feet above the station and for 500 feet below; there is a riffle 1,000 feet above and one three hundred feet below the station. The right bank overflows in extreme stages, such as the floods of 1865 and 1869, while the left bank is high and does not overflow. The bed of the creek is of gravel and is permanent.

Discharge measurements are taken from the downstream side of the bridge, the initial point for soundings being the right end of the downstream hand-rail.

A standard chain gage is attached to the downstream hand-rail of the bridge. The length of chain from the bottom of the weight to the marker is 29.68 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a projection on stone 2.7 feet in from face of right abutment, downstream side or wing, lowest stone; dog mark on stone, elevation 7.088 feet above zero of gage. Bench Mark No. 2 is a projection on stone 8.8 feet in from face of right abutment, downstream side, fourth stone in from face of abutment, fourth stone up from ground. The gage is read twice daily by Howard Harris.

Since the establishment of this station 30 discharge measurements have been taken. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF PINE CREEK, AT WATERVILLE, LYCOMING COUNTY, PA.

(Drainage area 750 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
30	1913 March 4	Boehringer & Batley,	230	533	1.36	2.66	723	0.6 msmt. Nearly ⅓ of creek was frozen area.

DISCHARGE TABLE FOR PINE CREEK, AT WATERVILLE, LYCOMING COUNTY, FROM JULY 16TH, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.60	25	3.00	1835	.40	6160	.80	12700	.20	20750
.70	40	.10	1960	.50	6410	.90	13000	.30	21120
.80	60	.20	2090	.60	6660	8.00	13300	.40	21490
.90	95	.30	2220	.70	6910	.10	13600	.50	21870
1.00	130	.40	2355	.80	7165	.20	13900	.60	22260
.10	175	.50	2500	.90	7420	.30	14200	.70	22650
.20	225	.60	2645	6.00	7675	.40	14510	.80	23045
.30	280	.70	2790	.10	7930	.50	14830	.90	23445
.40	335	.80	2935	.20	8185	.60	15160	11.00	23850
.50	400	.90	3090	.30	8440	70	15490	.10	24250
.60	465	4.00	3250	.40	8700	.80	15820	.20	24650
.70	535	.10	3410	.50	8965	.90	16150	.30	25060
.80	610	.20	3575	.60	9230	9.00	16490	.40	25450
.90	695	.30	3750	.70	9500	.10	16830	.50	25850
2.00	780	.40	3940	.80	9775	.20	17170	.60	26260
.10	870	.50	4130	.90	10060	.30	17515	.70	26670
.20	965	.60	4320	7.00	10325	.40	17860	.80	27080
.30	1065	.70	4520	.10	10610	.50	18210	.90	27490
.40	1165	.80	4740	.20	10905	.60	18570	12.00	27900
.50	1265	.90	4970	.30	11200	.70	18930	.10	28320
.60	1370	5.00	5200	.40	11500	.80	19290	.20	28740
.70	1480	.10	5430	.50	11800	.90	19650	30	29160
.80	1595	.20	5670	.60	12100	10.00	20010	.40	29580
.90	1715	.30	5910	.70	12400	.10	20350	.50	30000

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF PINE CREEK AT WATERVILLE, LYCOMING COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	2.24	1000	....	500	......	1100	6.88	10000	4.63	4380	1.80	610	1.00	130	1.05	152	1.40	335	2.14	908	1.82	627	1.64	498
2, ...	2.14	908	....	500	......	1100	7.53	11900	4.13	3460	1.70	535	0.90	95	1.00	130	1.50	400	1.99	772	1.82	627	1.69	528
3, ...	2.14	908	....	500	......	1100	b7.83	12800	3.48	2470	1.75	572	0.90	95	1.10	175	2.00	780	1.89	686	1.77	588	2.14	908
4, ...	2.04	816	....	500	......	1109	6.93	10100	3.48	2470	1.70	535	0.90	95	1.10	175	2.15	918	1.79	602	1.72	550	3.09	1950
5, ...	*	750	....	500	......	1100	4.73	4590	3.28	2190	1.50	400	0.90	95	1.10	175	2.00	780	1.74	565	1.72	550	2.89	1700
6, ...	....	750	....	450	......	700	4.63	4380	2.78	1570	1.50	400	0.90	95	1.00	130	1.90	695	1.69	528	1.62	479	3.54	2560
7, ...	....	750	....	450	......	700	4.83	4920	3.78	2910	1.45	368	0.90	95	1.00	130	1.75	572	1.64	498	1.97	754	3.14	2010
8, ...	....	750	....	450	......	700	5.68	6860	4.48	4090	1.40	335	0.90	95	1.00	130	1.60	465	1.54	426	3.12	1990	2.89	1700
9, ...	....	750	....	450	......	700	4.68	4480	4.38	3900	1.30	280	0.90	95	1 10	175	1.48	337	1.49	394	3.32	2250	2.89	1700
10, ...	....	750	....	450	......	700	4.03	3300	3.83	2980	1.30	280	0.90	95	1.00	130	1.42	348	1.44	361	2.97	1800	2.79	1580
11, ...	....	700	....	425	......	700	3.58	2620	3.83	2260	1.20	225	0.90	95	1.25	252	1.40	335	1.44	361	2.82	1620	2.69	1470
12, ...	....	700	....	425	......	750	3.38	2330	3.23	2130	1.20	225	1.15	200	1.50	400	1.40	335	1.44	361	2.72	1500	2.54	1310
13, ...	....	700	....	425	......	750	3.38	2330	4.13	3460	1.20	225	1.18	215	1.30	280	1.35	308	1.49	394	2.62	1390	2.39	1160
14, ...	....	700	....	425	......	750	3.31	2230	3.43	2400	1.20	225	1.00	130	1.25	252	1.30	280	1.54	426	2.57	1340	2.14	908
15, ...	....	700	....	425	†3.78	2830	3.23	2130	3.28	2190	1.20	225	1.00	130	1.10	175	1.30	280	1.44	361	2.42	1180	1.99	772
16, ...	....	650	....	500	5.41	6180	4.13	3460	4.83	3810	1.30	280	1.00	130	1.00	130	1.37	318	1.44	361	2.27	1040	1.99	772
17, ...	....	650	....	500	4.58	4280	4.08	3300	5.73	6990	1.20	225	1.05	152	1.15	200	1.37	318	1.44	361	2.22	985	1.89	686
18, ...	....	650	....	500	4.61	4340	3.78	2910	4.83	4810	1.20	225	1.20	225	1.30	280	1.32	291	1.34	302	2.12	889	1.89	686
19, ...	....	650	....	500	5.18	5620	3.38	2330	4.08	3300	1.15	200	1.70	535	1.40	335	1.27	264	1.34	302	2.02	798	1.89	686
20, ...	....	650	....	500	5.61	6680	3.11	1970	3.33	2260	1.10	175	1.55	432	1.45	368	1.27	264	1.34	302	1.92	712	1.89	686
21, ...	....	600	....	600	4.78	4700	2.88	1690	2.98	1810	1.10	175	1.45	368	1 35	308	1.27	264	1.34	302	1.92	712	1.79	602
22, ...	....	600	....	600	4.13	3460	2.73	1510	2.88	1690	1.10	175	1.35	308	1.30	280	1.17	210	1.44	361	1.82	627	1.79	602
23, ...	....	600	....	600	3.61	2660	2.78	1570	2.56	1330	1.10	175	1.25	252	1.25	252	1.22	236	1.54	426	1.82	627	1.79	602
24, ...	....	600	....	600	3.23	2130	2.58	1350	2.40	1160	1.10	175	1.10	175	1.20	225	1.77	588	2.09	861	1.82	627	1.69	528
25, ...	....	600	....	600	2.93	1750	2.48	1200	2.25	1020	1.10	175	1.20	225	1.10	175	3.07	1920	2.39	1160	1.82	627	1.69	528
26, ...	....	550	....	2450	3.21	2100	2.33	1100	2.05	825	1.00	130	1.50	400	1.20	225	2.82	1620	2.34	1100	1.82	627	1.59	458
27, ...	....	550	....	2450	2.71	1490	2.23	995	1.95	738	1.00	130	1.30	280	1.10	175	2.62	1390	2.24	1060	1.82	627	1.59	458
28, ...	....	550	....	2450	3.48	2470	2.23	995	1.80	610	1.00	130	1.10	175	1.25	252	2.37	1140	2.24	1000	1.82	627	1.59	458
29, ...	....	550	....	2450	5.78	7110	2.48	1240	1.85	652	0.90	95	1.10	175	1.20	225	2.27	1040	2.09	861	1.67	514	1.69	528
30, ...	....	550	....	......	a6.68	9450	4.68	4480	2.05	825	1.10	175	1.00	130	1.15	200	2.47	1240	2.04	816	1.67	514	1.79	602
31, ...	....	550	....	......	5.98	7500	......	......	1.90	695	....	......	1.10	175	1.30	280	....	......	1.94	729	....	......	1.94	729

*Creek frozen over. †Ice went out. a Max. 7.03′ at 7 a. m.; 10400 sec. ft. b Max. 8.33′ at 7:15 a. m.; 14300 sec. ft. Discharge Jan. 5 to March 14, inclusive, estimated from climatological records.

ESTIMATED MONTHLY DISCHARGE OF PINE CREEK, AT WATERVILLE, LYCOMING COUNTY, PA.

(Drainage area 750 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	683	0.911	1.050
February,	....	....	765	1.020	1.100
March,	10400	....	2797	3.729	4.299
April,	14300	995	3840	5.120	5.712
May,	6990	610	2430	3.240	3.735
June,	610	95	269	0.359	0.401
July,	585	95	190	0.253	0.292
August,	400	130	218	0.291	0.335
September,	1920	210	611	0.815	0.910
October,	1160	302	577	0.769	0.887
November,	2250	479	927	1.236	1.379
December,	2560	458	979	1.305	1.504
The year,	....	....	1190	1.587	21.604

Note.—Discharge Jan. 5 to March 14, inclusive, estimated from climatological records.

LYCOMING CREEK.

DESCRIPTION OF BASIN.

Lycoming creek, a tributary of the West Branch of the Susquehanna river in the central part of Lycoming county, drains an approximate area of 275 square miles. Rising in the southwestern corner of Bradford county, it flows in a general southerly direction through Bradford, Tioga and Lycoming counties, a distance of 34 miles, to its mouth, a short distance above Williamsport. The upper portion of this stream and its tributaries lie within the glacial area, in a sparsely inhabited region, well covered with second growth timber, the valleys being generally narrow, the side hills high and steep and the fall rapid. Throughout the lower section the valley is wide and the stream has a flat slope through an agricultural region. There are numerous small tributaries, the largest being Roaring Branch. Only a few villages lie along this stream, the larger being near the mouth. This creek and its tributaries are used to some extent for power purposes by grist mills.

The mean annual precipitation over the greater portion of this watershed is from 40 to 45 inches.

The discharge of this creek has been measured since July 14, 1908, at Bridge No. 2 of the Northern Central Railroad, three miles above the mouth.

LYCOMING CREEK AT BRIDGE No. 2, NEAR WILLIAMSPORT.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 14th, 1908, in co-operation with the Northern Central Railroad Company, at a single span, steel, through truss, highway bridge, just above the Northern Central Railroad Bridge No. 2, about three miles from Williamsport. It is the second highway bridge above the mouth, the Northern Central Railroad bridge crossing the creek on a skew about 200 feet below the station.

The channel is straight for one-quarter mile above the station, and is straight for several hundred feet below, with a riffle about 600 feet below. Both banks are high and only overflow during extreme high water. The bed is of rocks, gravel and clay, and is fairly permanent. The current is sluggish and the channel deep. A fish dam 300 feet downstream was partially destroyed in the fall of 1908, and entirely destroyed during the summer of 1910.

Discharge measurements are taken from the downstream side of the bridge during high stages, and by wading just below the bridge during low stages of the creek. Initial point for soundings is edge of bridge seat on downstream side of left abutment.

A standard chain gage is bolted to the lower chord eyebar on the upstream side of the bridge. The length of chain from the bottom of weight to the marker is 19.41 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is on right abutment, upstream face, furthest upstream point on top of projecting course, eighth course down from bridge seat, elevation, 8.184 feet above gage datum. Bench Mark No. 2 is on left abutment, upstream corner of second course from bottom, course being only three inches thick; elevation, 5.872 feet above gage datum. The gage is read twice daily by the trackwalker of the Northern Central Railroad Company.

On account of the change in channel conditions, due to the fish dam which existed below the station, two rating curves have been computed.

Since the establishment of this station 26 discharge measurements have been made. Data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF LYCOMING CREEK, AT BRIDGE NO. 2, NEAR WILLIAMSPORT, LYCOMING COUNTY, PA.

(Drainage area 268 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
26	1913. March 4,	Boehringer & Batley.	121	583	0.46	2.77	268	0.6 measurement.

DISCHARGE TABLE FOR LYCOMING CREEK, AT BRIDGE NO. 2, LYCOMING COUNTY FROM JULY 14th, 1908 TO DEC. 31st, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.30	5	.80	770	.30	2070	.80	3425	.30	4800
.40	15	.90	845	.40	2160	.90	3530	.40	4890
.50	25	4.00	925	.50	2250	7.00	3620	.50	4985
.60	40	.10	1005	.60	2340	.10	3710	.60	5075
.70	60	.20	1090	.70	2430	.20	3800	.70	5165
.80	90	.30	1175	.80	2525	.30	3890	.80	5255
.90	130	.40	1260	.90	2620	.40	3980	.90	5345
3.00	185	.50	1350	6.00	2710	.50	4075	9.00	5440
.10	250	.60	1440	.10	2800	.60	4165	.50	5915
.20	320	.70	1530	.20	2890	.70	4255	10.00	6390
.30	390	.80	1620	.30	2980	.80	4350	.10	6485
.40	460	.90	1710	.40	3070	.90	4440		
.50	535	5.00	1800	.50	3160	8.00	4530		
.60	610	.10	1890	.60	3250	.10	4620		
.70	690	.20	1980	.70	3340	.20	4710		

DISCHARGE TABLE FOR LYCOMING CREEK, AT BRIDGE NO. 2, LYCOMING COUNTY, FROM JAN. 1ST., 1910.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
2.20	42	2.40	60	2.60	85	2.80	125	3.00	200
.30	50	.50	70	.70	100	.90	160	.10	250

NOTE.—This rating table is only applicable for low water subsequent to 1909. Regular rating table used above 3.1 feet.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF LYCOMING CREEK, AT BRIDGE NO. 2, NEAR WILLIAMSPORT, LYCOMING COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	......	260	......	180	......	400	6.50	3160	4.80	1620	2.60	85	2.30	50	2.20	42	2.50	70	*3.60	610	*2.60	85	2.70	100
2, ...	......	260	......	180	......	400	7.05	3660	4.60	1440	2.60	85	2.30	50	2.20	42	2.50	70	*3.60	610	*2.60	85	3.55	572
3, ...	......	260	......	180	......	400	7.00	3620	4.45	1300	2.55	78	2.30	50	2.20	42	2.50	70	*3.60	610	2.60	85	4.60	1440
4, ...	......	260	......	180	......	400	6.70	3340	4.20	1090	2.50	70	2.30	50	2.20	42	2.50	70	*3.50	535	2.60	85	4.55	1400
5, ...	......	260	......	180	......	400	6.20	2890	3.90	845	2.50	70	2.30	50	2.20	42	2.50	70	*3.50	585	2.60	85	4.50	1850
6, ...	......	235	......	165	......	250	6.05	2760	3.90	845	2.50	70	2.30	50	2.20	42	2.50	70	3.50	535	2.60	85	4.40	1260
7, ...	......	235	......	165	......	250	5.65	2380	3.80	770	2.50	70	2.30	50	2.20	42	2.50	70	3.50	585	4.35	1220	4.35	1220
8, ...	......	235	......	165	......	250	5.50	2250	3.75	730	2.40	60	2.30	50	2.20	42	2.50	70	3.50	585	d6.45	3120	4.20	1090
9, ...	......	235	......	165	......	250	5.25	2020	3.90	845	2.40	60	2.30	50	2.60	85	2.50	70	3.50	585	4.70	1530	4.00	925
10, ...	......	235	......	165	......	250	4.80	1620	4.05	965	2.40	60	2.30	50	b5.15	1940	2.50	70	3.45	498	3.75	730	3.80	770
11, ...	......	235	......	155	......	250	4.75	1580	3.90	845	2.40	60	2.30	50	4.15	1050	2.50	70	3.45	498	3.35	425	3.35	425
12, ...	......	235	......	155	......	270	4.40	1260	4.35	1220	2.40	60	2.30	50	3.80	770	2.50	70	3.45	498	3.10	250	3.15	285
13, ...	......	235	......	155	......	270	4.40	1260	4.20	1090	2.40	60	2.30	50	3.15	285	2.50	70	3.05	225	3.00	200	3.00	200
14, ...	......	235	......	155	......	270	4.40	1260	4.10	1005	2.40	60	2.30	50	2.95	180	2.50	70	2.90	160	3.00	200	2.85	142
15, ...	......	235	......	155	‡5.40	2160	4.40	1260	4.30	1180	2.40	60	2.30	50	2.65	92	2.40	60	2.90	160	3.00	200	2.80	125
16, ...	......	235	......	200	5.05	1840	4.40	1260	4.65	1480	2.40	60	2.30	50	2.60	85	2.40	60	2.80	125	3.00	200	2.80	125
17, ...	......	235	......	200	5.50	2250	4.40	1260	4.90	1710	2.40	60	2.30	50	2.60	85	2.40	60	2.75	112	3.00	200	2.80	125
18, ...	......	235	......	200	5.40	2160	4.55	1400	4.40	1260	2.40	60	3.30	50	2.60	85	2.40	60	2.60	85	3.00	200	2.80	125
19, ...	......	235	......	200	5.60	2340	4.40	1260	4.05	965	2.35	55	2.30	50	2.50	70	2.40	60	2.60	85	2.95	180	2.80	125
20, ...	......	235	......	200	5.95	2660	4.40	1260	3.80	770	2.30	50	2.30	50	2.55	78	2.40	60	2.60	85	2.90	160	2.80	125
21, ...	......	235	......	200	5.70	2430	3.95	885	3.55	572	2.30	50	2.30	50	2.60	85	2.40	60	2.60	85	2.80	125	2.80	125
22, ...	......	235	......	200	4.70	1530	3.90	845	3.30	390	2.25	46	2.30	50	2.65	92	2.40	60	2.60	85	2.75	112	2.80	125
23, ...	......	235	......	200	4.70	1530	3.80	770	3.20	320	2.30	50	2.45	65	2.75	112	2.40	60	2.60	85	2.70	100	2.80	125
24, ...	......	235	......	200	4.45	1300	3.60	610	3.10	250	2.30	50	2.40	60	2.70	100	c6.35	3020	2.60	85	2.70	100	2.80	125
25, ...	......	235	......	200	4.70	1530	3.45	498	3.00	200	2.30	50	2.55	78	2.70	100	5.35	2120	2.60	85	2.70	100	2.80	125
26, ...	......	235	......	880	4.70	1530	3.35	425	2.90	160	2.30	50	2.50	70	2.95	180	4.20	1090	2.60	85	2.70	100	2.80	125
27, ...	......	235	......	880	5.85	2570	3.20	320	2.80	125	2.30	50	2.30	50	2.90	160	3.90	845	*2.60	85	2.70	100	2.80	125
28, ...	......	235	......	880	a7.80	4350	3.20	320	2.75	112	2.30	50	2.20	42	2.75	112	3.60	610	*2.60	85	2.70	100	2.80	125
29, ...	......	235	......	880	7.05	3660	3.85	808	2.65	92	2.30	50	2.20	42	2.70	100	*3.60	610	*2.60	85	2.70	100	2.80	125
30, ...	......	235	......	....	6.50	3160	4.80	1620	2.60	85	2.30	50	2.20	42	2.70	100	*3.60	610	*2.60	85	2.70	100	2.80	125
31, ...	......	235	......	....	5.65	2380	......	....	2.60	85	......	....	2.20	42	2.50	70	......	....	*2.60	85	......	....	2.75	112

Creek frozen Jan. 1-Mar. 14 inc. Discharge estimated from run-off of Pine creek. ‡Ice went out. *Estimated. a=Max. 8.10 at 2.45 p. m.; 4620 sec. ft. b=Max. 5.30 at 8:30 a. m.; 2070 sec. ft. c=Max. 6.80 at 1:45 p. m.; 3440 sec ft. d=Max. 6.90 at 8:45 a. m.; 3530 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF LYCOMING CREEK, AT BRIDGE NO. 2, NEAR WILLIAMSPORT, LYCOMING COUNTY, PA.

(Drainage area 268 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	239	0.892	1.028
February,	....	....	277	1.034	1.115
March,	4620	....	1409	5.257	6.061
April,	3660	320	1600	5.970	6.661
May,	1710	85	786	2.933	3.381
June,	85	46	60	0.224	0.250
July,	78	42	51	0.190	0.219
August,	2070	42	205	0.765	0.882
September,	3440	60	348	1.298	1.448
October,	....	85	274	1.022	1.178
November,	3530	85	345	1.287	1.436
December,	1440	100	429	1.601	1.846
The year,	....	....	502	1.873	25.505

Note.—Discharge January 1 to March 14, inc., estimated from run-off of Pine creek.

SUSQUEHANNA BASIN—STATION NO. 14.

WEST BRANCH OF SUSQUEHANNA RIVER AT WILLIAMSPORT.

DESCRIPTION OF STATION.

This station was established by the United States Weather Bureau on March 1st, 1895, at the Market Street Bridge, Williamsport.

The channel is about 1,000 feet wide at the station, broken by four piers. It is straight for one-half mile above, to a low wooden dam, while below it is straight for several hundred feet. Both banks are high and rocky and do not overflow. There is a fair velocity, except at low stages, when wading measurements are made just below the dam above the bridge. The bed is of rock and gravel, and fairly permanent.

Discharge measurements are taken from the upstream side of the bridge, the initial point for soundings being the face of the left abutment.

A standard chain gage is fastened to the upstream hand-rail in the first span from the left end. Length of chain from bottom of weight to the marker is 40.22 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is cut in face of left abutment, elevation 10 feet above gage datum. The gage is read once daily by H. H. Guise, Clerk in the City Engineer's office.

Since the establishment of this station 30 discharge measurements have been made. The following gage heights have been furnished by the U. S. Weather Bureau. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WEST BRANCH SUSQUEHANNA RIVER, AT WILLIAMSPORT, LYCOMING COUNTY, PA.

(Drainage area 5,680 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
30	1913. March 5,	Boehringer & Batley.	877	5142	1.54	3.31	7906	0.6 measurement.

DISCHARGE TABLE FOR WEST BRANCH SUSQUEHANNA RIVER AT WILLIAMSPORT, LYCOMING COUNTY, FROM JANUARY 1ST, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.00	250	.50	8090	7.00	22900	.50	42220	14.00	69100
.10	370	.60	8400	.10	23400	.60	42840	.10	70000
.20	495	.70	8710	.20	23900	.70	43480	.20	70900
.30	630	.80	9030	.30	24400	.80	44120	.30	71800
.40	775	.90	9360	.40	24900	.90	44760	.40	72700
.50	930	4.00	9690	.50	25400	11.00	45400	.50	73650
.60	1090	.10	10040	.60	25920	.10	46050	.60	74600
.70	1260	.20	10400	.70	26440	.20	46700	.70	75550
.80	1440	.30	10770	.80	26960	.30	47350	.80	76500
.90	1630	.40	11150	.90	27480	.40	48050	.90	77450
1.00	1820	.50	11540	8.00	28000	.50	48750	15.00	78400
.10	2010	.60	11940	.10	28540	.60	49450	.10	79400
.20	2210	.70	12340	.20	29080	.70	50150	.20	80400
.30	2410	.80	12750	.30	29620	.80	50900	.30	81400
.40	2620	.90	13170	.40	30160	.90	51650	.40	82400
.50	2830	5.00	13600	.50	30700	12.00	52400	.50	83400
.60	3050	.10	14030	.60	31240	.10	53150	.60	84400
.70	3270	.20	14470	.70	31780	.20	53900	.70	85400
.80	3500	.30	14910	.80	32340	.30	54650	.80	86400
.90	3740	.40	15350	.90	32900	.40	55450	.90	87400
2.00	3980	.50	15800	9.00	33460	.50	56250	16.00	88400
.10	4220	.60	16250	.10	34020	.60	57050	.50	93500
.20	4470	.70	16700	.20	34580	.70	57850	17.00	98600
.30	4720	.80	17150	.30	35140	.80	58650	.50	103800
.40	4970	.90	17600	.40	35700	.90	59450	18.00	109000
.50	5230	6.00	18060	.50	36260	13.00	60300	.50	114800
.60	5490	.10	18520	.60	36840	.10	61150	19.00	119600
.70	5750	.20	18980	.70	37420	.20	62000	.50	124900
.80	6020	.30	19460	.80	38000	.30	62850	20.00	130200
.90	6300	.40	19940	.90	38580	.40	63700	.50	135600
3.00	6580	.50	20420	10.00	39180	.50	64600	21.00	141000
.10	6870	.60	20900	.10	39780	.60	65500		
.20	7170	.70	21400	.20	40380	.70	66400		
.30	7470	.80	21900	.30	40980	.80	67300		
.40	7780	.90	22400	.40	41600	.90	68200		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WEST BR. SUSQUEHANNA RIVER AT WILLIAMSPORT, LYCOMING COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.
1, ...	5.20	14500	....	3400	7.90	27500	14.30	71800	8.95	33200	3.10	6870	0.10	370	0.60	1090	1.00	1820	5.30	14900	4.35	11000	2.65	5620
2, ...	5.00	13600	....	3400	7.60	25900	11.90	51600	7.80	27000	3.00	6580	0.10	370	0.40	775	1.60	3050	5.00	13600	2.70	5750	2.60	5490
3, ...	4.90	13200	....	3400	6.90	22400	17.40	103000	6.95	22600	2.90	6300	0.10	370	0.40	775	1.90	3740	4.80	12800	2.55	5360	2.45	5100
4, ...	4.60	11900	....	3400	5.50	15800	14.70	75600	5.90	17600	2.70	5750	0.10	370	0.30	630	4.80	12800	3.00	6580	2.20	4470	3.40	7780
5, ...	....	5100	....	3400	5.10	14000	10.10	39800	5.45	15600	2.30	4720	0.10	370	0.30	630	7.00	22900	2.80	6020	1.95	3860	3.55	8240
6, ...	....	5100	....	3400	4.80	12800	9.10	34000	5.25	14700	1.90	3740	0.20	495	0.20	495	6.30	19500	2.50	5230	1.85	3620	4.05	9860
7, ...	....	5100	....	3400	4.10	10000	8.00	28000	5.20	14500	1.80	3500	0.30	630	0.30	630	4.30	10600	2.30	4720	2.00	3980	4.40	11200
8, ...	....	5100	....	3400	3.80	9080	7.50	25400	5.65	16500	1.80	3500	0.20	495	0.30	630	4.10	10000	2.20	4470	2.95	6440	3.95	9520
9, ...	....	5100	....	3400	3.70	8710	8.40	30200	6.70	21400	1.60	3050	0.20	495	0.30	630	3.80	9080	2.00	3980	3.60	8400	3.60	8400
10, ...	....	5100	....	3400	3.90	9360	7.80	27000	6.75	21600	1.40	2620	0.00	250	1.30	2410	3.50	8090	1.70	3270	4.85	13000	3.25	7320
11, ...	....	5100	....	3400	4.90	13200	7.10	23400	6.85	19700	1.30	2410	0.10	370	1.80	3500	3.30	7470	1.80	3500	5.85	15100	3.05	6720
12, ...	....	5100	....	3400	4.90	13200	5.70	16700	5.90	17600	1.20	2210	0.10	370	2.50	5230	3.10	6870	1.70	3270	4.50	11500	2.90	6800
13, ...	....	5100	....	3400	5.60	16200	5.50	15800	4.95	13400	1.10	2010	0.60	1090	2.00	3980	2.80	6020	2.10	4220	4.05	9860	2.75	5880
14, ...	....	5100	....	3400	5.80	17200	5.00	13600	5.40	15400	1.10	2010	0.40	775	1.40	2620	2.50	5230	2.30	4720	4.40	11200	2.60	5490
15, ...	....	5100	....	3400	5.50	15800	5.30	14900	5.25	14700	1.00	1820	0.30	630	1.00	1820	2.40	4970	2.30	4720	4.15	10200	2.45	5100
16, ...	....	5100	....	3400	a13.95	68600	5.60	16200	4.95	18400	0.90	1630	0.20	495	0.80	1440	2.40	4970	2.20	4470	3.85	9200	2.35	4840
17, ...	....	5100	....	3400	10.40	41600	5.40	15400	5.40	15400	1.10	2010	0.20	495	0.70	1260	2.20	4470	2.00	3980	3.70	8710	2.40	4970
18, ...	....	5100	....	3400	9.70	37400	5.20	14500	10.95	45100	1.40	2620	0.30	630	1.10	2010	2.30	4720	1.70	3270	3.55	8240	2.25	4600
19, ...	....	5100	....	3400	9.10	34000	5.20	14500	10.30	41000	1.20	2210	0.50	930	1.30	2410	2.20	4470	1.70	3270	3.30	7470	2.50	5230
20, ...	....	5100	....	3400	8.40	30200	5.00	13600	7.15	23600	0.90	1630	0.30	630	1.30	2410	1.90	3740	1.60	3050	3.25	7320	2.65	5620
21, ...	....	5100	....	4600	8.30	29600	5.00	13600	5.85	17400	0.80	1440	0.50	930	1.20	2210	1.90	3740	1.60	3050	3.15	7020	2.45	5100
22, ...	....	5100	....	4600	10.00	39200	4.80	12800	5.00	13600	0.50	930	0.90	1630	1.00	1820	1.90	3740	1.60	3050	3.20	7170	2.50	5230
23, ...	....	5100	....	4600	9.80	38000	4.50	11500	4.85	13000	0.40	775	1.20	2210	1.00	1820	1.80	3500	1.50	2830	3.05	6720	2.35	4840
24, ...	....	5100	....	4600	9.40	35700	4.20	10400	4.50	11500	0.30	630	1.30	2410	0.90	1630	2.70	5750	1.70	3270	2.90	6300	2.30	4720
25, ...	....	5100	....	4600	9.00	33500	3.90	9360	4.10	10000	0.30	630	1.40	2620	1.00	1820	5.60	16200	2.00	3980	2.75	5880	2.25	4600
26, ...	....	5100	....	4600	8.20	29100	3.90	9360	3.90	9360	0.20	495	1.70	3270	1.20	2210	6.30	19500	2.20	4470	2.85	6160	2.25	4600
27, ...	....	5100	4.90	13200	7.40	24900	3.90	9360	3.60	8400	0.20	495	1.50	2830	1.10	2010	6.60	20900	5.00	13600	2.70	5750	2.20	4470
28, ...	....	5100	5.50	15800	6.80	21900	3.70	8710	3.50	8090	0.20	495	1.20	2210	1.00	1820	5.10	14000	5.80	17200	2.65	5620	2.15	4340
29, ...	....	5100	7.90	27500	8.20	29100	3.80	9030	3.40	7780	0.20	495	1.00	1820	1.10	2010	5.30	14900	6.20	19000	2.60	5490	2.00	3980
30, ...	....	5100	....	......	9.80	38000	4.20	10400	3.20	7170	0.00	250	0.60	1090	0.80	1440	5.40	15400	4.90	18200	2.45	5100	1.95	3860
31, ...	....	5100	....	......	16.00	88400	......	......	3.10	6870	......	......	0.70	1260	0.80	1440	....	......	4.60	11900	....	......	2.10	4220

a=Maximum 18.40 at 4:30 p. m.; 113000 sec. ft. Jan. 5 to Feb. 26, inc., discharge estimated for climatological records.

ESTIMATED MONTHLY DISCHARGE OF WEST BRANCH SUSQUEHANNA RIVER, AT WILLIAMSPORT, LYCOMING COUNTY.

(Drainage area 5,680 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	6160	1.085	1.251
February,	....	....	5240	.923	.995
March,	113000	8710	27400	4.824	5.561
April,	108000	8710	25000	4.401	4.910
May,	45100	6870	17300	3.046	3.512
June,	6870	250	2460	.433	.483
July,	3270	250	1060	.187	.216
August,	5230	495	1790	.315	.363
September,	22900	1820	9080	1.599	1.784
October,	19000	2880	6760	1.190	1.372
November,	15100	3620	7530	1.326	1.480
December,	11200	3860	5910	1.040	1.199
The year,	....	....	9640	1.697	23.126

Note.—Jan. 5th to Feb. 26th, incl., discharge estimated from climatological records.

LOYALSOCK CREEK.

DESCRIPTION OF BASIN.

Loyalsock creek, a tributary of the West Branch of the Susquehanna river, drains an area of approximately 495 square miles in Bradford, Wyoming, Sullivan and Lycoming counties. Rising in many swamps in the western part of Wyoming county, this stream flows southwesterly through a wild, rugged and sparsely inhabited country, except on the plateaus, where some farming is carried on, through Sullivan county into Lycoming county, to its mouth at Montoursville, a total distance of about 60 miles. This entire stream, except for a short distance above its mouth, is steep and rapid, flowing through narrow valleys with steep, precipitous sides, with frequent low falls along its course. All but a small section of this basin near the mouth lies within the glacial area, and many of the numerous tributaries rise in lakes or swamps, the most important tributary being Little Loyalsock creek. There are a few small boroughs and farming villages on the watershed, but the stream is not used for water supply and but little for water power.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge of this stream has been measured since July 17, 1908, at Forksville, Sullivan county.

SUSQUEHANNA BASIN—STATION NO. 15

LOYALSOCK CREEK AT FORKSVILLE.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 17, 1908, at a single span, wooden covered, highway bridge, Forksville, Sullivan county.

The channel above the station is straight for 300 feet, while below it is straight for 200 feet. The right bank is high and does not overflow and the left bank overflows only during extreme high stages. The bed is of rocks and gravel.

Discharge measurements are made by wading either above or below the bridge.

A standard chain gage is attached to the bridge. The length of chain from bottom of weight to marker is 21.88 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is corner stone on left abutment, downstream corner, tenth course down under seat of arch haunch, second course up from ground; elevation, 4.13 feet above zero of gage. Bench Mark No. 2 is corner of stone on left abutment, up stream corner seventh course down from seat of arch haunch, seventh course up from bottom, close to iron hitching ring for boats on end of old retaining wall log; elevation 6.387 feet above zero of gage. The gage is read twice daily by B. W. Fawcett.

A dam crosses the creek about 100 feet below the bridge, but does not influence the gage readings. Little Loyalsock creek enters about 800 feet downstream.

Since the establishment of this station three discharge measurements have been made. No discharge measurements have been made during 1912. Owing to the insufficient number of discharge measurements, no rating curve has been computed, and only the daily gage heights have been published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DAILY MEAN GAGE HEIGHTS OF BIG LOYALSOCK CREEK, AT FORKSVILLE, SULLIVAN COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	2.14	1.54	1.90	3.18	2.78	1.84	1.44	1.30	1.52	2.52	2.28	2.22
2,	2.28	1.51	1.82	3.40	2.71	1.85	1.40	1.32	2.65	2.42	2.70	3.30
3,	2.34	1.48	1.75	3.58	2.62	1.83	1.36	1.35	2.82	2.28	2.38	3.30
4,	2.30	1.45	1.75	3.50	2.56	1.82	1.35	1.32	2.22	2.19	2.31	2.95
5,	2.26	1.45	1.70	3.22	2.55	1.81	1.58	1.30	2.14	2.14	2.26	2.78
6,	2.24	1.42	1.62	3.15	2.46	1.80	1.65	1.30	2.08	2.08	2.25	2.92
7,	2.20	1.40	1.60	3.08	2.52	1.78	1.59	1.28	2.02	1.98	2.62	2.75
8,	2.14	1.38	1.68	2.92	2.85	1.75	1.55	1.25	1.94	1.91	3.65	2.62
9,	2.10	1.35	1.70	2.82	2.79	1.72	1.51	1.30	1.89	1.90	3.02	2.56
10,	2.10	1.35	1.65	2.75	2.75	1.69	1.55	2.18	1.84	1.96	2.82	2.52
11,	2.04	1.32	1.78	2.68	2.80	1.65	1.58	2.42	1.79	2.08	2.72	2.42
12,	2.00	1.30	2.10	2.65	2.88	1.62	1.54	2.25	1.74	2.01	2.56	2.32
13,	1.96	1.30	2.40	2.62	3.22	1.59	1.49	1.90	1.70	2.08	2.48	2.22
14,	1.91	1.28	2.58	2.62	2.85	1.56	1.44	1.68	1.68	2.02	2.44	2.12
15,	1.85	1.26	3.75	2.65	2.72	1.55	1.39	1.61	1.61	1.95	2.39	2.08
16,	1.85	1.25	3.90	2.80	2.80	1.55	1.36	1.52	2.02	1.91	2.34	2.05
17,	1.84	1.25	3.42	3.02	2.85	1.55	1.35	1.46	1.92	1.86	2.29	2.02
18,	1.81	1.29	3.12	2.98	2.82	1.53	1.32	1.49	1.85	1.81	2.24	2.20
19,	1.80	1.30	3.15	2.90	2.78	1.52	1.32	1.68	2.72	1.92	2.19	2.55
20,	1.86	1.58	3.20	2.82	2.72	1.50	1.31	1.71	2.40	1.86	2.14	2.15
21,	1.84	1.80	3.05	2.72	2.64	1.50	1.30	1.66	2.15	1.84	2.10	2.09
22,	1.80	1.95	2.82	2.65	2.38	1.55	1.30	1.65	2.22	1.80	2.06	2.05
23,	1.78	2.00	2.68	2.61	2.28	1.55	1.30	1.72	2.72	1.91	2.04	2.01
24,	1.75	2.12	2.58	2.58	2.24	1.53	1.30	1.84	3.95	1.92	2.02	2.02
25,	1.71	2.22	2.50	2.46	2.18	1.52	1.34	1.89	4.12	2.15	2.12	2.12
26,	1.69	2.40	2.42	2.32	2.09	1.50	1.39	1.82	3.95	2.42	2.16	2.20
27,	1.65	2.75	2.45	2.35	1.99	1.50	1.36	1.74	3.82	2.38	2.18	2.14
28,	1.65	2.40	2.75	2.34	1.91	1.48	1.31	1.68	3.40	2.31	2.10	2.10
29,	1.61	2.00	4.22	3.18	1.85	1.45	1.30	1.61	2.75	2.22	2.14	2.12
30,	1.59	....	3.50	2.85	1.85	1.45	1.28	1.56	2.62	2.14	2.10	2.20
31,	1.55	....	3.15	....	1.83	....	1.28	1.54	....	2.08	....	2.16

Note.—No ice conditions reported.

RAYSTOWN BRANCH JUNIATA RIVER.

DESCRIPTION OF BASIN.

With the Frankstown Branch, which it joins six miles below Huntingdon, the Raystown Branch forms the Juniata river. This branch rises on the eastern slope of the Allegheny mountains in the eastern part of Somerset county, and passing into Bedford county, flows easterly to near its eastern border, where it turns northward following a most tortuous course into Huntingdon county at Saxton. Through Huntingdon county it follows a winding, serpentine course, in a general northwest direction, to its mouth. The total length of the stream is approximately 110 miles, and its drainage basin comprises 1,012 square miles. The largest tributaries are Trough, Yellow, Shavers, Cove and Dunning creeks. In the western part of Bedford county the stream drains a limestone region, while its larger tributaries drain well timbered, sparsely developed areas. The tributaries coming in from the east between Hopewell and Saxton drain the Broad-top mountain soft coal district, while Great Trough creek drains the coal district at Robertsdale and Woodvale.

In Bedford county the stream and its tributaries are considerably used for domestic and industrial water supply. At Hawn's Bridge, Huntingdon county, some 10 or 12 miles above the mouth, a 28-foot dam has been built, and a 3,600 h. p. water power plant erected. For over 40 miles above its mouth there is no railroad in the valley, which is quite an exception for so large a stream.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since August 31st, 1911, at Saxton, Bedford county.

SUSQUEHANNA BASIN—STATION NO. 16.

RAYSTOWN BRANCH JUNIATA RIVER AT SAXTON.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on August 31st, 1911, on a two span, steel, through truss, highway bridge, between Stonestown and Saxton Furnace, to replace the station at Hawn's Bridge, which was discontinued owing to the construction of a dam immediately above the gage.

The channel is approximately straight for 300 feet above the station, and is straight for 300 feet below. The right and left banks are high and overflow only during extreme high stages. The bed is of sand, gravel and stones, and is fairly permanent.

Discharge measurements are taken from the downstream side of the bridge, the initial point for soundings being the bridge pin, right downstream side.

A chain gage, with removable weight and chain, is attached to the floor on the downstream side of the bridge. The length of chain from bottom of weight to marker is 23.00 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a chiselled mark on stone on right downstream wingwall, on top of stone twelfth course down from top, and fifth course from bottom; elevation, 9.65 feet above zero of gage. The gage is read twice daily by W. C. Jenkins.

The flow under the bridge at low water is very sluggish, with no flow or water in the left channel.

Since the establishment of this station seven discharge measurements have been made, but owing to the insufficient number of measurements, no rating table has been computed for this station, and only the discharge measuremets and gage heights have been published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF RAYSTOWN BRANCH, JUNIATA RIVER, AT SAXTON, BEDFORD COUNTY, PA.

(Drainage area 790 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912.							
7	Dec. 17,	Boehringer & Reckord.	139	267	1.22	1.42	325	0.6 measurement.

DAILY MEAN GAGE HEIGHTS OF RAYSTOWN BR. OF JUNIATA RIVER AT SAXTON, BEDFORD COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	4.10	†3.31	3.18	4.05	3.78	1.75	1.79	2.22	1.26	2.21	1.45	1.27
2,	3.36	*3.25	2.66	3.92	3.49	1.84	1.62	2.09	1.26	2.08	1.37	1.33
3,	3.20	*3.22	2.88	4.28	3.21	1.96	1.49	2.09	1.81	1.98	1.23	1.37
4,	2.95	*3.09	2.38	4.00	2.97	1.74	1.36	1.99	2.66	1.71	1.30	1.57
5,	2.48	*2.99	2.22	3.42	2.77	1.56	1.47	1.82	2.58	1.65	1.37	1.37
6,	*2.05	*2.96	2.12	3.15	2.59	1.50	1.36	1.66	2.16	1.54	1.33	1.65
7,	*3.90	*3.19	2.06	2.95	2.81	1.42	1.29	1.58	1.88	1.46	1.35	2.05
8,	*3.65	*3.08	2.24	2.95	4.24	1.38	1.31	1.51	1.81	1.41	g3.90	2.10
9,	*3.95	*2.77	2.80	2.72	3.63	1.40	1.27	1.48	1.71	1.42	3.05	2.08
10,	*4.15	*2.77	2.72	2.52	3.22	1.60	1.35	1.67	1.52	1.74	2.79	1.87
11,	*4.20	*2.73	2.19	2.42	2.89	1.28	1.39	1.79	1.41	2.35	2.37	1.58
12,	*4.20	*2.69	2.20	2.32	3.08	1.23	1.33	1.61	1.32	1.70	2.25	1.33
13,	*4.10	*2.63	2.47	2.34	d8.09	1.18	1.32	1.69	1.26	1.58	2.14	1.23
14,	*3.85	*2.59	3.35	2.40	5.34	1.20	1.29	1.75	1.22	1.48	2.00	1.33
15,	*3.72	*2.53	b6.69	2.32	4.59	1.19	1.35	1.53	1.18	1.34	1.93	1.43
16,	*3.60	*2.48	7.14	2.18	4.69	2.23	1.27	1.41	1.24	1.24	1.87	1.63
17,	*3.60	*2.39	5.00	2.28	7.71	c5.48	1.45	1.32	1.22	1.12	1.77	1.50
18,	*3.69	*2.87	4.38	c4.78	5.54	3.86	3.88	1.28	1.28	1.18	1.63	1.48
19,	*3.75	*2.89	4.28	4.41	4.49	2.88	5.12	1.35	1.21	1.18	1.50	1.58
20,	*3.88	*3.27	5.12	3.66	3.89	2.88	3.49	1.63	1.22	1.11	1.46	1.55
21,	*3.99	*4.05	6.95	3.30	3.39	2.10	4.42	1.71	1.18	1.24	1.55	1.50
22,	*3.56	‡5.42	8.24	3.20	3.04	2.03	f6.09	1.65	1.16	1.24	1.58	1.40
23,	*3.45	‡5.73	5.90	3.24	2.77	1.96	4.82	1.45	1.31	1.46	1.35	1.10
24,	*3.59	‡5.15	5.25	2.94	2.57	1.80	5.27	1.33	1.76	1.64	1.37	1.18
25,	†4.08	‡5.02	5.40	2.76	2.34	2.13	4.62	1.35	5.06	1.94	1.43	1.30
26,	†4.60	a5.97	4.50	2.75	2.17	2.06	4.12	1.29	4.94	1.88	1.35	1.38
27,	†4.15	7.72	4.16	3.35	2.05	1.98	3.39	1.22	4.68	1.71	1.35	1.50
28,	†3.90	5.13	3.96	3.55	2.01	1.80	2.85	1.19	3.40	1.62	1.35	1.32
29,	†3.85	4.07	4.96	3.38	2.03	1.70	2.55	1.23	2.98	1.54	1.33	1.18
30,	†3.62	....	5.60	3.72	2.01	2.10	3.17	1.19	2.68	1.58	1.27	1.60
31,	†3.62	....	4.78	....	1.94	....	2.59	1.29	....	1.54	....	2.30

Notes.—*Creek frozen over; gage heights to surface of ice. †Gage heights to surface of water; ice gorge below gage. ‡Ice gorge above and below gage. Gage heights to water over ice. aIce went out. bMax. 8.74′ at 7:00 p. m. cMax. 5.05′ at 5:45 p. m. dMax. 8.59′ at 7:45 a. m. eMax. 5.88′ at 7:45 a. m. fMax. 6.52′ at 6:15 a. m. gMax. 4.55′ at 8.00 a. m.

FRANKSTOWN BRANCH JUNIATA RIVER.

DESCRIPTION OF BASIN.

The Frankstown Branch of the Juniata river drains approximately 995 square miles in Bedford, Blair and Huntingdon counties. Rising in the northern part of Bedford county, this stream flows first in a general northerly direction to Hollidaysburg; thence northeasterly through Blair county to Petersburg, Huntingdon county, where it flows southeasterly to its junction with the Raystown Branch, a total distance of approximately 58 miles, the general outline of the basin being fan shaped. The headwaters lie high up on the Allegheny Mountains, but as the stream descends it enters a fertile, well settled, agricultural valley, through which it flows to Petersburg and thence through a deep gorge, cutting through a succession of ridges to its confluence, six miles below Huntingdon, with the Raystown Branch. The mountains in this basin are well covered with second growth timber, but the valleys are almost deforested. The upper section of the basin contains limestone formation, from which issues numerous large springs, which materially assists the flow in dry weather. As a whole the watershed is thickly settled, especially along the banks of the river, and its principal tributaries, of which Little Juniata is the most important, there being one city, Altoona, and many large industrial boroughs and villages scattered over the area. The river and its tributaries are extensively used for water supply, both domestic and industrial.

The source of the Frankstown Branch lies at an elevation of approximately 1,300 feet, and in a distance of 26 miles, to Hollidaysburg, (elevation 930) the flow is at the rate of 20 feet per mile; from this point to Huntingdon (elevation 610) 28 miles further downstream, the rate of fall is 12 feet per mile. The bed is rocky throughout most of its course, with gravel and sand deposits at intervals in the less rapid portions.

A concrete dam 28 feet in height, erected and used for the generation of water power, crosses the river at Warrior Ridge, five miles above Huntingdon, creating slack water for about three miles.

The mean annual precipitation over practically the entire watershed is from 40 to 45 inches.

Discharge has been measured since May 1, 1895, at Huntingdon, six miles above the confluence with the Raystown Branch.

FRANKSTOWN BRANCH JUNIATA RIVER AT HUNTINGDON.

DESCRIPTION OF STATION.

This station was established by the United States Weather Bureau on May 1, 1895, on the county highway bridge at the foot of Fourth street, Huntingdon. On November 1st, 1890, the Weather Bureau began readings on a gage painted on the Fourth Street Bridge pier, graduated to feet and half-feet. On August 31st, 1893, readings on this gage were discontinued, and were commenced on May 1st, 1895, supposedly on the same gage, but the zero of this latter gage seems to be about three feet lower than the former. This gage was used until 1899 or 1900, when the present staff gage was installed at the same datum. On July 24th, 1907, the Water Supply Commission of Pennsylvania began making discharge measurements, in order to rate this station.

The channel is straight for 500 feet above and below the station. The right bank is low and overflows during high stages, while the left bank is high and does not overflow.

In order that the discharge of the entire stream may be obtained, during freshets, when the water passes around the Fourth Street Bridge, discharge measurements are taken from a steel, highway bridge, about one-fourth mile above the gage. Low water measurements are taken at the Fourth Street Bridge by wading. The initial point for soundings is left end of top angle of hand-rail, downstream side of highway bridge.

A two-inch by ten-inch oak staff gage, painted white, with black graduations to feet and tenths, is fastened to the first pier from the north end of the Fourth Street Bridge. The elevation of zero is 597.4 feet above mean sea level. Bench Mark No. 1, which was located on an arch over a head race near the Fourth Street Bridge, has been obliterated. Bench Mark No. 2 is top edge of outer corner of left abutment, downstream side of Fourth Street Bridge; elevation 22.50 feet above gage datum. The gage is read thrice daily by Lawrence White.

Since the Juniata Hydro-Electric Company, five miles above, at Warrior Ridge, began operating its plant in the spring of 1908, low water readings are affected by storage at this plant, due to the placing of flash boards on the dam. As a result of these conditions, the minimum discharge for the month of February, 1912, is exceedingly low.

Since the establishment of this station 25 discharge measurements have been made.

The daily gage heights for the first part of 1912 were furnished by the U. S. Weather Bureau. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF FRANKSTOWN BRANCH JUNIATA RIVER, AT HUNTINGDON, HUNTINGDON COUNTY, PA.

(Drainage area 345 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912.							
25	Dec. 17,	Boehringer & Reckord.	261	776	0.91	3.80	704	0.6 measurement.

DISCHARGE TABLE FOR FRANKSTOWN BRANCH JUNIATA RIVER, AT HUNTINGDON, HUNTINGDON COUNTY, FROM JAN. 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.40	70	.80	1950	.20	6810	.60	13420	12.00	23530
.50	85	.90	2100	.30	7050	.70	13740	.10	24100
.60	100	5.00	2260	.40	7290	.80	14070	.20	24690
.70	125	.10	2430	.50	7540	.90	14410	.30	25300
.80	150	.20	2600	.60	7790	10.00	14750	.40	25900
.90	175	.30	2770	.70	8040	.10	15100	.50	26590
3.00	200	.40	2950	.80	8300	.20	15450	.60	27250
.10	250	.50	3140	.90	8560	.30	15810	.70	27920
.20	300	.60	3330	8.00	8820	.40	16180	.80	28600
.30	350	.70	3520	.10	9090	.50	16560	.90	29290
.40	400	.80	3710	.20	9360	.60	16950	13.00	30000
.50	460	.90	3900	.30	9640	.70	17350	.10	30720
.60	520	6.00	4100	.40	9920	.80	17760	.20	31460
.70	600	.10	4310	.50	10200	.90	18180	.30	32220
.80	700	.20	4520	.60	10480	11.00	18620	.40	33000
.90	800	.30	4730	.70	10760	.10	19070	.50	33800
4.00	900	.40	4950	.80	11040	.20	19530	.60	34600
.10	1010	.50	5170	.90	11320	.30	20000	.70	35400
.20	1120	.60	5400	9.00	11600	.40	20480	.80	36200
.30	1250	.70	5630	.10	11890	.50	20970	.90	37000
.40	1380	.80	5860	.20	12180	.60	21460	14.00	37800
.50	1510	.90	6090	.30	12480	.70	21960		
.60	1650	7.00	6330	.40	12790	.80	22470		
.70	1800	.10	6570	.50	13100	.90	22990		

Note.—This table is only applicable subsequent to Jan. 1. 1912, and is based on five discharge measurements made during 1910-11-12, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF FRANKSTOWN BR. JUNIATA RIVER AT HUNTINGDON, HUNTINGDON COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G H	Dis.	G. H.	Dis	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	5.10	2430	4.70	1800	4.70	1800	6.30	4730	5.60	3330	3.70	600	2.95	183	3.43	418	3.57	502	4.00	900	3.87	770	3.23	315
2, ...	4.80	1950	3.90	800	4.70	1800	6.20	4520	5.30	2770	3.50	460	3.10	250	3.40	400	3.70	600	4.23	1160	3.83	730	3.90	800
3, ...	4.60	1650	4.30	1250	4.40	1380	6.90	6090	5.00	2260	3.70	600	3.17	285	3.37	385	4.53	1550	4.10	1010	3.23	315	3.37	385
4, ...	4.50	1510	3.70	600	4.50	1510	5.90	3900	4.80	1950	3.80	700	3.08	215	3.63	544	4.23	1160	3.87	770	3.73	630	3.50	460
5, ...	4.70	1800	3.80	700	4.00	900	5.50	3140	4.50	1510	2.70	125	3.17	285	3.40	400	3.73	630	3.47	442	3.80	700	3.73	630
6, ...	3.10	250	3.00	200	3.70	600	5.30	2770	4.50	1510	3.70	600	3.10	250	3.43	418	3.77	670	3.73	630	3.53	478	4.57	1610
7, ...	4.20	1120	3.20	300	3.70	600	5.00	2260	4.40	1380	3.60	520	3.27	335	3.23	315	3.50	460	3.53	478	4.37	1340	4.70	1800
8, ...	4.70	1800	3.90	800	4.60	1650	5.20	2600	5.60	3330	3.60	520	3.17	285	3.13	265	3.50	460	3.47	442	5.23	2650	4.08	933
9.	3.20	300	4.10	1010	5.00	2260	4.80	1950	5.00	2260	3.00	200	3.20	300	3.48	418	3.30	350	3.40	400	4.63	1700	4.10	1010
10, ...	4.40	1380	2.90	175	4.40	1380	4.60	1650	4.80	1950	2.80	150	3.20	300	3.37	385	3.37	385	3.43	418	4.13	1040	4.07	977
11, ...	3.90	800	3.80	700	4.10	1010	4.40	1380	4.60	1650	2.70	125	3.20	300	3.67	576	3.43	418	3.87	770	4.37	1340	4.10	1010
12, ...	4.50	1510	2.90	175	4.60	1650	4.30	1250	4.40	1380	2.60	100	3.10	250	3.50	460	3.40	400	3.37	385	4.23	1160	4.23	1160
13, ...	3.10	250	3.90	800	3.90	800	4.30	1250	5.00	2260	2.60	100	3.23	315	3.33	365	3.40	400	3.00	200	4.30	1250	2.77	142
14, ...	4.20	1120	3.20	300	4.90	2100	3.70	600	4.70	1800	2.60	100	3.17	285	3.23	315	3.27	335	3.57	502	4.17	1090	3.70	600
15, ...	4.90	2100	3.00	200	8.70	10800	4.50	1510	4.30	1250	2.60	100	3.37	385	3.27	335	2.90	175	3.27	335	3.90	800	3.50	460
16, ...	3.40	400	2.70	125	8.00	8320	4.50	1510	a6.75	5740	2.80	150	3.10	250	3.67	576	3.67	576	3.67	576	3.67	576	3.57	502
17, ...	4.60	1650	3.50	460	6.20	4520	4.50	1510	8.00	8820	6.00	4100	3.73	630	3.40	400	3.40	400	3.40	400	3.43	418	3.70	600
18, ...	4.30	1250	2.50	85	6.40	4950	5.70	3520	6.30	4730	4.60	1650	4.87	2060	2.87	168	3.40	400	3.33	365	3.90	800	3.47	442
19, ...	3.90	800	3.70	600	6.40	4950	5.60	3380	5.50	3140	3.60	520	3.93	830	3.43	418	3.37	385	3.17	285	3.80	700	3.50	460
20, ...	4.40	1380	2.80	150	6.70	5630	5.10	2480	5.20	2600	3.60	520	3.57	502	3.40	400	3.67	576	3.57	502	3.77	670	3.53	478
21, ...	4.00	900	4.50	1510	6.70	5630	4.80	1950	4.90	2100	3.30	350	4.00	900	3.67	576	3.10	250	3.40	400	3.57	502	3.40	400
22, ...	4.40	1380	4.20	1120	6.70	5630	4.80	1950	4.70	1800	3.20	300	6.13	4370	3.67	576	2.63	108	3.23	315	3.57	502	3.27	335
23, ...	3.70	600	4.80	1950	5.90	3900	5.20	2600	4.40	1380	3.70	600	4.50	1510	3.30	350	3.53	478	3.87	770	3.53	478	3.13	265
24, ...	4.40	1380	3.90	800	6.00	4100	4.70	1800	4.20	1120	3.60	520	4.17	1090	3.50	460	5.17	2550	4.23	1160	3.33	365	3.47	442
25, ...	4.20	1120	3.90	800	6.40	4950	4.70	1800	4.20	1120	2.90	175	5.10	2430	2.73	132	6.20	4520	3.80	700	4.10	1010	2.77	142
26, ...	4.40	1380	5.40	2950	6.00	4100	4.50	1510	3.80	700	2.90	175	4.20	1120	3.33	365	5.03	2310	4.17	1090	3.37	385	2.67	118
27, ...	4.40	1380	8.20	9360	6.50	5170	4.40	1380	4.20	1120	2.80	150	3.67	576	3.27	335	5.50	3140	3.93	830	3.43	418	3.53	478
28, ...	4.10	1010	5.50	3140	7.70	8040	4.60	1650	3.90	800	2.70	125	3.67	576	3.33	365	4.80	1950	3.97	870	3.08	215	3.00	200
29, ...	3.60	520	5.00	2260	8.40	9920	4.60	1650	3.90	800	2.70	125	3.67	576	3.33	365	4.17	1090	3.97	870	3.27	335	2.70	125
30, ...	3.40	400	......	....	8.30	9640	6.10	4810	4.00	900	3.60	520	3.70	600	3.30	350	4.50	1510	3.87	770	3.27	335	3.73	630
31, ...	3.50	460	......	....	6.90	6090	......	....	3.70	600	......	....	3.40	400	3.23	315	......	....	3.63	544	......	....	4.73	1840

a=Max. 9.20′ at 7:00 p. m.; 12200 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF FRANKSTOWN BRANCH, JUNIATA RIVER, AT HUNTINGDON, HUNTINGDON COUNTY, PA.

(Drainage area 845 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	2430	250	1160	1.373	1.583
February,	9360	85	1210	1.432	1.544
March,	10600	600	4070	4.817	5.553
April,	6090	600	2420	2.864	3.195
May,	12200	600	2200	2.604	3.002
June,	4100	100	499	0.591	0.659
July,	4370	188	731	0.865	0.997
August,	576	132	392	0.464	0.535
September,	4520	108	958	1.134	1.265
October,	1160	200	622	0.736	0.849
November,	2650	215	790	0.935	1.044
December,	1840	118	637	0.754	0.869
The year,	12200	85	1307	1.547	21.095

KISHACOQUILLAS CREEK.

DESCRIPTION OF BASIN.

Kishacoquillas creek joins the Juniata river at Lewistown, 45 miles above the river's mouth, from the northeast, draining 195 square miles, practically all of which lies in Mifflin county. It is formed by the East and West Branches, which join at Reedville, both branches and its other tributaries rising in the sandstone ridges, while the main stream valley and those of the two branches for some miles above their junction lie in the limestone, resulting in a well maintained flow. Its course is southwesterly and its length from Reedville is five and one-half miles, the basin being fan shaped. The main valley is densely populated and water is used for industrial, domestic and water power purposes. Its larger upper tributaries as they emerge from the sandstone area are used for supplying Reedville, Burnham, Yeagertown and Lewistown.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since August 21, 1911, at Kulp's, two miles above the mouth.

KISHACOQUILLAS CREEK AT KULP'S.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on August 21st, 1911, and is located on a two span, wooden, highway bridge, at Kulp's.

The channel is straight above and below the station for 300 feet, with riffles about 100 feet below the bridge. The right bank is high but overflows during extreme stages, while the left bank is high and does not overflow. The bed is of rocks and mud and is fairly permanent. There is slight velocity under the bridge at low stages.

Discharge measurements are taken from the downstream side of the bridge, and by wading at low stages 150 feet above the bridge. The initial point for soundings is top edge of left abutment, downstream side.

A staff gage is bolted to the upstream face of the left abutment. The elevation of zero is arbitrary datum. Bench Mark No. 1 is mark chiselled on stone in fourth row from top, upstream face, left abutment; elevation 5.87 feet above gage datum. The gage is read twice daily by Thomas W. Hawke.

Since the establishment of this station seven discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF KISHACOQUILLAS CREEK, AT KULPS, MIFFLIN COUNTY, PA.

(Drainage area 190 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
7	1912. Dec. 9,	Reckord, ...	60	191	1.10	1.32	210	Surface measurement.

DISCHARGE TABLE FOR KISHACOQUILLAS CREEK, AT KULPS, MIFFLIN COUNTY, FROM AUGUST 21, 1911.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.60	14	.20	144	.80	378	.40	795	3.00	1410
.70	29	.30	176	.90	432	.50	886	.10	1530
.80	47	.40	211	2.00	493	.60	982	.20	1660
.90	68	.50	249	.10	562	.70	1084		
1.00	91	.60	288	.20	635	.80	1189		
.10	116	.70	330	.30	712	.90	1297		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF KISHACOQUILLAS CREEK AT KULPS, MIFFLIN COUNTY, PA

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	1.72	340	1.02	96	1.40	211	2.84	1230	2.80	712	1.43	222	0.88	64	1.15	130	1.16	133	1.29	173	0.88	64	1.07	108
2, ...	1.61	292	1.00	91	1.37	200	3.34	1840	2.24	666	1.40	211	0.86	60	0.99	89	1.18	138	1.24	157	1.04	101	1.15	130
3, ...	1.55	268	0.88	64	1.23	154	3.36	1860	2.14	591	1.64	305	1.00	91	1.01	94	1.06	106	1.20	144	0.98	86	1.24	157
4, ...	1.50	249	1.10	116	1.18	138	2.89	1290	2.03	514	1.45	230	1.04	101	1.07	108	0.74	36	1.18	138	1.08	111	1.18	138
5, ...	1.39	208	1.24	157	1.05	104	2.64	1020	1.94	456	1.38	204	1.03	98	0.85	58	0.90	68	1.14	127	0.91	70	1.14	127
6, ...	1.66	313	1.12	122	1.03	98	2.44	831	1.92	444	1.40	211	0.98	86	0.78	43	0.92	78	1.10	116	0.76	40	1.57	276
7, ...	1.36	197	1.02	96	1.14	127	2.36	762	2.13	584	1.42	219	1.00	91	1.06	111	0.98	86	1.12	122	2.08	548	1.41	215
8, ...	1.32	183	0.80	47	1.48	241	2.28	697	2.22	650	1.34	190	1.00	91	0.66	23	0.93	75	1.09	114	2.49	877	1.32	188
9, ...	1.27	166	0.86	60	1.58	280	2.13	584	2.30	712	1.24	157	1.12	122	0.81	49	1.10	116	1.08	98	1.97	475	1.30	176
10, ...	1.60	288	0.92	73	1.24	157	2.02	507	2.16	606	1.24	157	0.98	86	1.25	160	1.16	133	1.06	106	1.78	368	1.26	163
11, ...	1.24	157	1.11	119	1.24	157	1.96	469	2.08	548	1.23	154	0.86	60	1.44	226	0.87	62	1.10	116	1.68	322	1.28	170
12, ...	1.20	144	0.88	64	1.22	150	1.88	421	2.25	674	1.20	144	0.94	77	1.22	150	0.64	20	1.04	101	1.48	241	1.22	150
13, ...	1.14	127	0.92	73	1.89	427	1.90	432	2.86	1250	1.18	138	0.98	86	1.20	144	0.97	84	0.92	78	1.45	230	1.05	104
14, ...	1.34	190	0.80	47	1.40	211	1.81	383	2.48	868	1.17	136	0.89	66	1.18	138	0.90	68	0.75	38	1.54	265	1.24	157
15, ...	1.38	204	0.83	53	*5.50	e4500	1.79	378	2.34	745	1.16	133	0.98	86	0.92	73	0.70	29	0.90	68	1.30	176	1.14	127
16, ...	1.31	180	0.69	28	e4.20	e2940	1.98	481	a2.74	1130	1.27	166	0.86	60	1.07	108	0.72	33	0.89	66	1.40	211	1.22	150
17, ...	1.12	122	0.76	40	e4.00	e2690	1.92	444	2.62	1000	1.40	211	1.18	138	0.98	86	0.86	60	1.12	122	1.34	190	1.18	138
18, ...	1.10	116	0.79	45	e3.60	e2170	2.46	850	2.38	778	1.22	150	1.12	122	0.76	40	0.82	51	1.12	122	1.28	170	1.18	138
19, ...	1.12	122	1.00	91	e3.10	1530	2.30	712	2.26	681	1.20	144	0.89	66	1.00	91	1.02	96	0.92	78	1.26	163	1.30	176
20, ...	1.15	130	1.22	150	2.45	840	2.22	650	2.16	606	1.16	133	1.02	96	0.95	80	0.78	43	0.96	82	1.24	157	1.28	170
21, ...	1.08	111	1.10	116	2.48	822	2.10	562	2.05	528	1.09	114	b1.72	340	0.92	73	0.90	68	0.88	64	1.20	144	1.20	144
22, ...	1.07	108	1.87	416	2.24	666	2.04	521	1.94	456	1.04	101	1.45	230	1.16	133	0.80	47	0.97	84	1.20	144	1.16	133
23, ...	1.18	138	1.60	288	2.08	548	2.08	548	1.88	421	1.02	96	1.16	133	0.96	82	0.76	40	0.98	86	1.18	138	1.12	122
24, ...	1.24	157	1.46	231	2.21	643	1.96	469	1.81	383	1.03	98	1.13	124	1.04	101	1.88	421	1.14	127	1.17	136	1.16	133
25, ...	1.12	122	2.12	577	2.35	754	1.97	475	1.74	349	1.02	96	1.17	136	0.67	24	2.15	598	0.75	38	1.18	138	1.10	116
26, ...	1.07	108	1.84	400	2.40	795	1.33	394	1.66	313	0.86	60	1.01	94	0.70	29	1.78	368	1.12	122	1.17	136	1.14	127
27, ...	1.06	106	2.44	831	2.69	1070	1.92	444	1.62	296	0.99	89	0.96	82	0.64	20	1.64	305	1.14	127	1.09	114	1.16	133
28, ...	1.06	106	1.66	313	3.41	e1920	1.83	394	1.62	296	1.08	111	0.71	31	1.16	133	1.52	257	0.92	78	1.12	122	1.16	138
29, ...	1.04	101	1.52	257	4.14	e2370	2.03	514	1.62	296	1.08	111	1.14	127	1.18	138	1.40	211	1.10	116	1.10	116	1.08	111
30, ...	1.01	94	....	......	3.78	e2420	2.41	804	1.56	272	1.04	101	1.14	127	1.03	98	1.37	200	1.15	130	1.08	111	1.22	150
31, ...	1.00	91	....	......	3.26	e1740	......	....	1.50	249	......	....	0.92	73	0.92	73	......	....	1.14	127	......	....	1.54	265

*Gage carried out by high water. Replaced March 20th. a=Max. 3.2 at 5:25 p. m.; e1710 sec. ft. b=Max. 2.40 at 6:05 p. m.; 795 sec. ft. e=Estimated.

ESTIMATED MONTHLY DISCHARGE OF KISHACOQUILLAS CREEK, AT KULPS, MIFFLIN COUNTY, PA.

(Drainage area 190 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	340	91	169	0.889	1.025
February,	831	28	175	0.921	0.993
March,	e4500	98	1020	5.368	6.189
April,	e1860	373	699	3.679	4.105
May,	e1710	249	583	3.068	3.537
June,	305	60	153	0.805	0.898
July,	795	31	105	0.553	0.638
August,	226	20	94	0.495	0.570
September,	598	20	134	0.705	0.786
October,	173	38	105	0.553	0.638
November,	877	40	205	1.079	1.204
December,	276	104	152	0.800	0.922
The year,	e4500	20	300	1.576	21.505

eEstimated.

TUSCARORA CREEK.

DESCRIPTION OF BASIN.

Tuscarora creek, an important tributary of the Juniata river, joining that stream at Port Royal, from the south, rises in the southeastern part of Huntingdon county and flows northeasterly through that county into Juniata county, and thence in the same direction to the river. Its total length is approximately 45 miles and its total drainage area approximately 256 square miles, its watershed being long, straight and narrow. The only large tributary is Licking creek, which, after flowing nearly parallel to the parent stream for several miles, joins it just above the river. Licking creek is used for industrial water supply. The valley is well cultivated as are some of the hillsides, while the hill tops are well timbered. The main stream is unused for water supply and little for power.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since August 21st, 1911, at Groninger's Bridge, four miles above the mouth.

TUSCARORA CREEK NEAR PORT ROYAL.

DESCRIPTION OF STATION.

This station was established on August 21st, 1911, by the Water Supply Commission of Pennsylvania, and is located on a single span, steel, through truss, highway bridge, about four miles above Port Royal.

The channel above the station is straight for 150 feet, with bend to left, while below the station it is straight for 200 feet. The right and left banks are low but do not overflow except during extreme stages. The bed is of gravel and rocks and is fairly permanent. There is a good velocity at all stages.

Measurements are taken from the downstream side of the bridge and by wading 100 feet upstream during low stages. The initial point for soundings is bridge pin, downstream right abutment.

A chain gage is bolted to the floor on the upstream side of the bridge. The length of chain from the bottom of the weight to the marker is 21.70 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is shelf in stone on face of right abutment, seventh course from top, second in from downstream corner, 0.54 feet down from top of stone; elevation 9.71 feet above gage datum. The gage is read twice daily by G. W. Groninger.

Since the establishment of this station 12 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF TUSCARORA CREEK, NEAR PORT ROYAL, JUNIATA COUNTY, PA.

(Drainage area 205 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
12	1912. Dec. 9,	Reckord, ...	78	113	0.86	2.75	97	Surface measurement.

DISCHARGE TABLE FOR TUSCARORA CREEK, NEAR PORT ROYAL, JUNIATA COUNTY, FROM AUGUST 21, 1911.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.00	0	.70	295	.40	1210	.10	2575	.80	4340
.10	5	.80	335	.50	1275	.20	2665	.90	4460
.20	12	.90	375	.60	1345	.30	2755	9.00	4580
.30	20	4.00	420	.70	1415	.40	2850	.10	4700
.40	30	.10	465	.80	1490	.50	2950	.20	4820
.50	40	.20	510	.90	1565	.60	3050	.30	4945
.60	52	.30	560	6.00	1640	.70	3150	.40	5080
.70	65	.40	615	.10	1715	.80	3250	.50	5215
.80	80	.50	670	.20	1790	.90	3350	.60	5350
.90	97	.60	725	.30	1870	8.00	3455	.70	5485
3.00	115	.70	780	.40	1950	.10	3560	.80	5625
.10	135	.80	835	.50	2035	.20	3665	.90	5765
.20	155	.90	890	.60	2125	.30	3775	10.00	5905
.30	180	5.00	950	.70	2215	.40	3885		
.40	205	.10	1015	.80	2305	.50	3995		
.50	235	.20	1080	.90	2395	.60	4110		
.60	265	.30	1145	7.00	2485	.70	4225		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF TUSCARORA CREEK, NEAR PORT ROYAL, JUNIATA COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
	G. H.	Dis.	G. H	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	3.91	380	3.21	158	3.44	217	4.78	824	4.86	868	3.00	115	2.54	45	2.62	55	2.41	31	2.95	106	2.40	30	2.48	38
2, ...	3.63	274	3.19	153	3.04	123	4.73	796	4.44	637	2.96	111	2.45	35	2.51	41	2.52	42	2.86	90	2.46	36	2.60	52
3, ...	3.50	235	3.16	147	4.14	483	5.22	1090	4.11	470	3.34	190	2.40	30	2.62	55	3.01	117	2.79	78	2.42	32	2.76	74
4, ...	3.43	214	3.04	123	4.73	796	4.66	758	3.88	367	3.06	127	2.38	28	2.72	68	3.12	139	2.78	77	2.50	40	2.76	74
5, ...	3.87	363	3.06	127	4.40	615	4.40	615	3.78	327	2.89	95	2.60	52	2.48	38	2.74	71	2.60	52	2.24	15	2.59	51
6, ...	3.57	256	3.06	127	4.53	714	4.19	506	3.67	286	2.97	110	2.52	42	2.41	31	2.64	57	2.66	60	2.46	36	2.95	106
7, ...	4.47	654	3.12	139	3.88	367	4.04	438	4.15	488	2.96	108	2.48	38	2.34	24	2.59	51	2.66	60	3.49	232	3.03	121
8, ...	4.15	488	3.06	127	3.30	180	4.12	474	6.76	2270	2.82	83	2.42	32	2.35	25	2.45	35	2.58	50	j5.28	1130	2.88	94
9, ...	4.10	465	3.07	129	3.84	351	3.80	335	6.15	1750	2.72	68	2.32	22	2.65	58	2.64	57	2.56	47	3.90	375	2.76	74
10, ...	3.85	355	3.06	127	3.24	165	3.74	311	5.02	968	2.78	77	2.24	15	3.53	244	2.36	26	2.62	55	3.26	170	2.54	45
11, ...	3.75	315	2.94	104	3.22	160	3.64	277	4.55	698	2.68	62	2.44	34	3.41	208	2.36	26	2.84	87	3.15	145	2.86	90
12, ...	3.73	307	2.96	108	3.14	143	3.52	241	4.50	670	2.68	62	2.42	32	3.44	217	2.26	17	2.67	61	3.01	117	2.98	111
13, ...	3.57	256	2.88	94	4.06	447	3.57	256	d11.28	7880	2.62	55	2.38	28	3.20	155	2.38	28	2.54	45	2.92	101	2.93	102
14, ...	3.42	211	3.04	123	4.26	540	3.54	247	5.96	1610	2.64	57	2.32	22	g3.44	217	2.37	27	2.60	52	3.01	123	3.08	131
15, ...	3.53	244	3.06	127	b8.30	3780	3.58	259	5.05	982	2.62	55	2.57	48	3.29	178	2.19	11	2.37	27	2.76	74	2.86	90
16, ...	3.47	226	3.02	119	6.56	2090	4.70	780	5.25	1110	3.01	117	2.60	52	2.96	108	2.62	55	2.64	57	2.78	77	2.78	77
17, ...	3.51	238	3.05	125	4.83	852	4.18	501	6.28	1850	e3.94	398	2.92	101	2.77	76	2.56	47	2.46	36	2.78	77	2.63	56
18, ...	3.47	226	3.04	123	4.48	659	c5.96	1610	5.34	1170	3.24	165	3.11	137	2.69	64	2.50	40	2.40	30	2.70	65	2.64	57
19, ...	3.45	220	3.22	160	4.21	515	5.40	1210	4.74	802	2.94	104	3.03	121	2.68	62	2.60	52	2.17	10	2.62	55	2.86	90
20, ...	3.57	256	3.50	235	4.60	725	4.72	791	4.34	582	2.78	77	2.60	52	2.53	44	2.41	31	2.42	32	2.57	48	3.12	139
21, ...	3.57	256	3.82	343	4.65	752	4.34	582	4.04	438	2.72	68	2.73	70	2.68	62	2.42	32	2.63	56	2.60	52	2.89	95
22, ...	3.40	205	5.82	1500	4.28	550	4.12	474	3.86	359	2.80	80	f4.42	626	2.61	57	2.28	18	2.55	46	2.59	51	2.86	90
23.	3.45	220	5.30	1140	4.14	483	4.48	632	3.72	303	2.80	80	3.28	175	2.57	48	2.51	41	2.48	38	2.57	48	2.85	88
24, ...	3.92	384	4.64	747	4.94	914	3.94	398	3.57	256	2.70	65	3.00	115	2.95	106	4.49	664	2.75	72	2.58	50	2.90	97
25, ...	3.73	307	4.77	818	5.26	1120	4.00	420	3.44	217	2.59	51	3.28	175	2.60	52	b5.94	1600	2.65	58	2.57	48	*2.67	61
26, ...	3.41	208	5.61	1350	5.24	1110	3.76	319	3.38	200	2.60	52	3.06	127	2.50	40	4.42	626	2.64	57	2.67	61	*2.66	60
27, ...	3.39	202	a6.44	1980	5.52	1290	4.58	686	3.24	165	2.54	45	2.87	92	2.46	36	3.76	319	2.64	57	2.64	57	*2.82	83
28, ...	3.29	178	4.40	615	5.92	1580	4.32	571	3.24	165	2.54	45	2.66	60	2.40	30	3.40	205	2.56	47	2.60	52	*2.84	87
29, ...	3.31	182	3.78	327	7.20	2660	4.40	615	3.32	185	2.52	42	2.59	51	2.40	30	3.16	147	2.52	42	2.54	45	*2.70	65
30, ...	3.26	170	......	....	6.28	1850	5.20	1080	3.30	180	2.57	48	2.66	60	2.31	21	3.05	125	2.32	22	2.46	36	*3.04	123
31, ...	3.31	182	......	....	5.28	1130	......	....	3.10	135	......	....	2.71	66	2.38	28	......	....	2.46	36	......	....	†4.22	520

a=Max. 7.08 at 7:35 a. m.; 2560 sec-ft. b=Max. 10.39 at 6:00 p. m.; 6450 sec-ft. (est.) c=Max. 6.48 at 6:20 p. m.; 2020 sec-ft. d=Max. 12.40 at 7:30 a. m.; 9950 sec-ft. (est.) e=Max. 4.23 at 6:00 p. m.; 525 sec-ft. f=Max. 4.69 at 5:00 a. m.; 774 sec-ft. g=Max. 3.81 at 6:00 p. m.; 339 sec-ft. h=Max. 6.86 at 7:00 a. m.; 1920 sec-ft. j=Max. 5.98 at 6:40 a. m.; 1620 sec-ft. *Creek frozen over. †Ice went out

ESTIMATED MONTHLY DISCHARGE OF TUSCARORA CREEK, NEAR PORT ROYAL, JUNIATA COUNTY.

(Drainage area 205 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean	Second-feet per square mile.	Depth in inches.
1912.					
January,	654	170	280	1.366	1.575
February,	2560	94	396	1.982	2.064
March,	6450	123	883	4.307	4.965
April,	2020	241	603	2.941	3.281
May,	9950	135	916	4.468	5.151
June,	525	42	94	0.459	0.512
July,	774	15	83	0.405	0.467
August,	339	21	80	0.390	0.450
September,	1920	11	158	0.771	0.860
October,	106	10	53	0.259	0.299
November,	1620	15	116	0.566	0.632
December,	520	33	98	0.478	0.551
The year,	9950	10	313	1.528	20.827

JUNIATA RIVER.

DESCRIPTION OF BASIN.

The Juniata river, the largest tributary of the Susquehanna river, below the forks, drains a crescent shaped area of approximately 3,450 square miles, lying in the southcentral part of Pennsylvania, and entirely within the Allegheny Mountains and their foot hills. This river is formed in Huntingdon county at a point six miles east of Huntingdon, by the junction of the Raystown and Frankstown Branches, the former rising on the eastern slope of the mountains in the eastern part of Somerset county, flowing eastward and then northeastward, with a drainage area of approximately 1,012 square miles, and the latter rising in the northwestern part of Bedford county, on the eastern slope of the Allegheny divide, and flowing northeasterly and then southeasterly, with a drainage area of approximately 995 square miles.

From the junction of the two branches, the Juniata river flows in a general easterly direction through Huntingdon, Mifflin, Juniata and Perry counties, to its mouth at Juniata Bridge, a total distance of about 80 miles. The valley of the stream is narrow, bounded by high bordering hills and flows in a winding course, cutting through a succession of sandstone ridges, the channel being generally on a rocky bed, with numerous riffles, separated by pools, in which sediment to considerable depth has collected at some points. The junction of the Frankstown and Raystown Branches lies at an approximate elevation of 610 feet and the mouth at 360 feet, making an average fall of three feet per mile. Draining, as this stream does, a section of the Allegheny Mountains, it has many tributaries flowing northerly and southerly between the ridges. The mountains are generally covered with second growth timber, but the larger valleys are deforested and used extensively for farming. The valleys of the river and its main tributaries are rather thickly populated, but the headwaters of the tributaries are sparsely inhabited. At one time this river was followed from its mouth to Hollidaysburg by the Pennsylvania Canal, long since abandoned, and replaced by the main line of the Pennsylvania Railroad.

The majority of the larger towns receive their domestic water supply from tributaries of the river; the river itself being thus used only in case of emergency, is, however, considerably employed for industrial purposes. Several of the lower tributaries, as well as both of the branches, drain areas of limestone, which contribute to maintain a fair low water flow.

The mean annual precipitation over almost the entire basin is from 40 to 45 inches.

The discharge has been measured since March 21, 1899, at Newport, twelve miles above the mouth.

SUSQUEHANNA RIVER—STATION NO. 20.

JUNIATA RIVER AT NEWPORT.

DESCRIPTION OF STATION.

This station was established by the U. S. Geological Survey on March 21, 1899, at a steel, through truss, highway bridge, near the Pennsylvania Railroad station at Newport. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania and has since been maintained and operated by this Commission.

The channel is straight for one-half mile above and below the station. The right and left banks are high and not subject to overflow. The bed is of hard material and permanent. There is a good measurable velocity under the bridge at all stages.

Discharge measurements are taken from the downstream side of the bridge; the initial point for soundings being end of hand-rail on right bank, downstream side.

On March 29th, 1905, a standard chain gage was fastened to the hand-rail on the downstream side of the bridge, in the first span. The length of chain from the bottom of weight to the marker is 36.84 feet. The elevation of zero is 363.32 feet above mean sea level (P. R. R. Levels). Bench Mark No. 1 is extreme east end of stone door-sill, east front of Ewing's store building, near end of bridge; elevation 28.83 feet above gage datum. This B. M. is not reliable on account of the step being worn considerably and should not be considered. Bench Mark No. 2 is on shelf in southeast corner of underpinning of store of J. M. Ewing; elevation, 28.87 feet above gage datum. Bench Mark No. 3 is top of fire plug in front of Ewing's Store; elevation, 29.75 feet above zero of gage, or 393.07 feet above mean sea level. (P. R. R. Bench). The gage is read twice daily by A. R. Bortel.

Since the establishment of this station 37 discharge measurements have been made. No discharge measurements have been made since the 1910-11 report of the Water Supply Commission, the data prior to January 1st, 1912, being contained therein.

DISCHARGE TABLE FOR JUNIATA RIVER, AT NEWPORT, PERRY COUNTY FROM JAN. 1ST., 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.60	470	.60	10880	.60	26780	.60	46540	.60	70120
.70	570	.70	11220	.70	27220	.70	47100	.70	70740
.80	680	.80	11560	.80	27660	.80	47660	.80	71360
.90	825	.90	11910	.90	28100	.90	48220	.90	71980
3.00	980	7.00	12260	11.00	28540	15.00	48780	19.00	72600
.10	1145	.10	12610	.10	28980	.10	49340	.10	73220
.20	1320	.20	12970	.20	29420	.20	49900	.20	73840
.30	1505	.30	13330	.30	29880	.30	50460	.30	74460
.40	1700	.40	13700	.40	30340	.40	51040	.40	75080
.50	1900	.50	14070	.50	30800	.50	51620	.50	75700
.60	2110	.60	14440	.60	31260	.60	52200	.60	76320
.70	2330	.70	14820	.70	31720	.70	52780	.70	76940
.80	2550	.80	15200	.80	32180	.80	53360	.80	77560
.90	2780	.90	15580	.90	32640	.90	53940	.90	78180
4.00	3020	8.00	15960	12.00	33100	16.00	54520	20.00	78800
.10	3270	.10	16350	.10	33580	.10	55100	.10	79420
.20	3530	.20	16740	.20	34060	.20	55680	.20	80060
.30	3800	.30	17130	.30	34540	.30	56260	.30	80700
.40	4070	.40	17520	.40	35020	.40	56840	.40	81340
.50	4350	.50	17920	.50	35500	.50	57440	.50	81980
.60	4630	.60	18320	.60	36000	.60	58040	.60	82620
.70	4910	.70	18720	.70	36500	.70	58640	.70	83260
.80	5200	.80	19120	.80	37000	.80	59240	.80	83900
.90	5490	.90	19520	.90	37500	.90	59840	.90	84540
5.00	5780	9.00	19940	13.00	38020	17.00	60440	21.00	85180
.10	6080	.10	20360	.10	38540	.10	61040	.10	85820
.20	6380	.20	20780	.20	39060	.20	61640	.20	86460
.30	6690	.30	21200	.30	39580	.30	62240	.30	87100
.40	7000	.40	21620	.40	40100	.40	62840	.40	87740
.50	7310	.50	22040	.50	40620	.50	63440	.50	88380
.60	7620	.60	22460	.60	41140	.60	64040	.60	89020
.70	7930	.70	22880	.70	41660	.70	64640	.70	89660
.80	8250	.80	23300	.80	42200	.80	65240	.80	90300
.90	8570	.90	23720	.90	42740	.90	65840	.90	90940
6.00	8890	10.00	24140	14.00	43280	18.00	66440	22.00	91580
.10	9210	.10	24580	.10	43820	.10	67040	.10	92220
.20	9540	.20	25020	.20	44360	.20	67640	.20	92860
.30	9870	.30	25460	.30	44900	.30	68260		
.40	10200	.40	25900	.40	45440	.40	68880		
.50	10540	.50	26340	.50	45980	.50	69500		

Note:—This table is only applicable subsequent to Jan. 1st, 1912, and is a combination of the former curve of the Water Supply Commission of Penna., and the 1910-11 U. S. G. S. curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF JUNIATA RIVER AT NEWPORT, PERRY COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.	GH	Dis.
1, ...	5.30	6690	......	2000	5.75	8090	8.50	17900	7.25	13100	4.10	3270	3.39	1680	3.97	2950	3.18	1200	4.53	4480	3.78	2400	3.43	1760
2, ...	5.40	7000	......	2000	5.05	5930	7.65	14600	6.60	10900	4.00	3020	3.45	1800	3.75	2440	3.18	1280	4.25	3660	3.55	2000	3.45	1800
3, ...	5.25	6540	......	2000	4.50	4350	8.60	18300	6.05	9050	4.00	3020	3.35	1600	3.65	2220	3.65	2220	4.05	3140	3.55	2000	3.55	2000
4, ...	4.85	5310	......	2000	4.38	4020	8.05	16200	5.65	7780	4.00	3020	3.30	1500	3.50	1900	4.20	3530	3.88	2780	3.57	2050	3.65	2220
5, ...	*4.45	4210	......	2000	4.05	3140	7.00	12300	5.50	7310	4.05	3140	3.28	1470	3.55	2000	4.10	3270	3.90	2780	3.82	1540	3.55	2000
6, ...	*4.25	3660	......	2000	4.05	3140	6.40	10200	4.98	5720	3.72	2870	3.25	1410	3.47	1840	3.80	2550	3.77	2480	3.55	2000	3.77	2480
7, ...	*3.80	2550	......	2000	3.88	2730	5.90	8570	5.02	5840	3.60	2110	3.18	1280	3.42	1740	3.60	3110	3.65	2220	3.67	2260	4.08	3100
8, ...	*3.35	1600	......	2000	4.02	3070	5.65	7780	6.35	10000	3.60	2110	3.22	1360	3.40	1700	3.55	2000	3.55	2000	5.40	7000	4.45	4210
9, ...	*3.70	2330	......	2000	4.65	4770	5.55	7460	7.50	14100	3.60	2110	3.16	1250	3.28	1470	3.60	2100	3.55	2000	5.75	8090	4.25	3660
10, ...	†	2300	......	2000	4.95	5640	5.35	6840	6.80	11600	3.60	2110	3.25	1410	3.55	2000	3.45	1800	3.55	2000	5.20	6380	4.05	3140
11, ...	......	2300	......	2000	4.50	4350	5.00	5780	5.95	8730	3.40	1700	3.10	1140	3.77	2480	3.35	1600	3.57	2050	4.75	5060	3.99	3000
12, ...	......	2300	......	2000	4.35	3940	4.80	5200	5.55	7460	3.35	1600	3.12	1180	4.05	3140	3.30	1500	3.65	2220	4.60	4630	3.90	2780
13, ...	......	2300	......	2000	4.75	5060	4.70	4910	9.90	23700	3.30	1500	3.08	1110	3.80	2550	3.20	1320	3.60	2110	4.33	3880	3.67	2260
14, ...	......	2300	......	2000	4.82	5260	4.60	4630	10.90	28100	3.30	1500	3.09	1130	3.55	2000	3.10	1140	3.62	2150	4.23	3610	3.70	2330
15, ...	......	2300	......	2000	8.00	16000	4.65	4770	8.05	16200	3.38	1660	3.25	1410	3.75	2440	3.11	1160	3.43	1760	4.12	3320	3.42	1740
16, ...	......	2300	......	2000	a13.60	41100	5.00	5780	6.70	11200	3.42	1740	3.13	1200	3.60	2110	3.13	1200	3.47	1840	4.05	3140	3.70	2330
17, ...	......	2300	......	2000	9.65	22700	4.80	5200	b10.25	25200	3.75	2440	3.19	1800	3.40	1700	3.08	1110	3.20	1820	3.97	2950	3.67	2260
18, ...	......	2300	......	2000	7.85	15400	5.85	8410	10.60	26800	6.80	11600	3.28	1470	3.40	1700	3.13	1200	3.39	1680	3.90	2780	3.67	2260
19, ...	......	2300	......	2000	7.45	13900	8.20	16700	8.25	16900	5.25	6540	3.65	2220	3.20	1820	3.35	1600	3.30	1500	3.80	2550	3.77	2480
20, ...	......	2300	......	2000	7.30	13300	7.60	14400	7.10	12600	4.55	4490	5.05	5980	3.20	1820	3.37	1640	3.30	1500	3.75	2440	3.80	2550
21, ...	......	2000	......	3000	8.25	16900	6.45	10400	6.20	9540	4.06	3140	4.70	4910	3.33	1560	3.33	1560	3.20	1320	3.75	2440	3.85	2660
22, ...	......	2000	......	3000	8.60	18800	5.85	8410	5.65	7780	3.85	2660	4.68	4850	3.36	1620	3.25	1410	3.25	1410	3.73	2400	3.70	2330
23, ...	......	2000	......	3000	9.90	23700	5.55	7460	5.22	6440	3.72	2370	6.75	11400	3.45	1800	3.27	1450	3.33	1560	3.65	2220	3.60	2110
24, ...	......	2000	......	3000	8.10	16400	5.65	7780	4.92	5550	3.70	2330	5.50	7310	3.50	1900	3.72	2370	3.30	1500	3.77	2480	3.45	1800
25, ...	......	2000	......	3000	8.60	18300	5.40	7000	4.82	5260	3.62	2150	4.80	5200	3.45	1800	c7.85	18500	3.90	2780	3.62	2150	3.50	1900
26, ...	......	2000	......	3000	8.70	18700	5.40	7000	4.50	4350	3.50	1900	5.30	6690	3.43	1760	7.05	12400	3.90	2780	3.60	2110	3.50	1900
27, ...	......	2000	11.60	31300	8.25	16900	5.55	7460	4.32	3850	3.50	1900	5.10	6080	3.15	1230	6.10	9210	4.00	3020	3.75	2440	3.35	1600
28, ...	......	2000	10.10	24600	9.15	20600	5.70	7930	4.40	4070	3.50	1900	4.40	4070	3.27	1450	5.55	7460	3.85	2660	3.53	1960	3.50	1900
29, ...	......	2000	7.05	12400	10.40	25900	5.70	7930	4.20	3530	3.50	1900	4.08	3220	3.15	1230	5.05	5930	3.70	2330	3.47	1840	3.55	2000
30, ...	......	2000	......	......	12.10	33600	6.50	10500	4.30	3800	3.55	2000	3.96	2900	3.23	1380	4.70	4910	3.80	2550	3.30	1500	3.55	2000
31, ...	......	2000	......	......	10.00	24100	......	......	4.20	3530	....	......	3.75	2440	3.16	1250	......	......	3.65	2220	....	....	3.90	2780

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*Floating ice in river. †River frozen Jan. 10 to Feb. 26 incl., and discharge estimated from W. Br. Susquehanna River at Renovo and climatological records. aMax. 13.81 at 8:00 a. m.; 42300 sec. ft. bMax. 11.42 at 5:00 p. m.; 30400 sec. ft. cMax. 7.78 at 5:00 p. m.; 14900 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF JUNIATA RIVER, AT NEWPORT, PERRY COUNTY, PA.

(Drainage area 3,380 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	2810	0.831	0.958
February,	31300	....	4360	1.290	1.391
March,	42300	2730	13500	3.994	4.605
April,	18300	4630	9260	2.740	3.057
May,	30400	3530	10600	3.136	3.616
June,	11600	1500	2780	0.822	0.917
July,	11400	1110	2970	0.879	1.014
August,	3140	1230	1870	0.553	0.638
September,	14900	1110	3190	0.944	1.053
October,	4430	1320	2250	0.666	0.768
November,	8090	1500	3050	0.902	1.006
December,	4210	1600	2370	0.701	0.808
The year,	....	....	4920	1.456	19.831

Note.—River frozen Jan. 10-Feb. 26 incl., discharge estimated from W. Br. Susquehanna River at Renovo and climatological records.

CONODOGUINET CREEK.

DESCRIPTION OF BASIN.

Conodoguinet creeek rises in the highlands of the west part of Franklin county, flows northeast through Franklin and Cumberland counties, to join the Susquehanna river opposite Harrisburg. Its course is tortuous and its current slow, and its valley in the lower section is deep and narrow. The total length of the creek is 75 miles and its drainage area 483 square miles. Its tributaries are generally short and unimportant, its watershed area being long and narrow. On the north the basin is bounded by a sandstone ridge, while to the south the valley is composed of rolling, limestone hills, highly cultivated. Carlisle and Mechanicsburg, and other smaller boroughs, lie in the valley of this stream; the former obtaining its water supply therefrom, and other towns receiving their supplies from the tributaries. It is considerably used for water power by grist mills, and a few small hydro-electric plants.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since September 26th, 1911, at Bryson's Bridge, 15 miles above the mouth.

CONODOGUINET CREEK AT BRYSON'S BRIDGE.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on September 26th, 1911, and is located on a two span, covered, wooden bridge, a few miles below Hogestown.

The channel is straight for 300 feet above and 500 feet below the station. There are riffles about 200 feet above the station. The right bank is high, while the left bank is low, but water at all stages passes under the bridge. The bed is of rock, sand and gravel.

Discharge measurements are taken from the downstream side of the bridge through the floor openings and by wading. The initial point for soundings is top edge of left abutment, downstream side.

A chain gage is attached to the lower chord on the downstream side of the bridge, near the left bank. The length of chain from the bottom of weight to the marker is 19.00 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is corner of protruding stone, third down from top, at bridge end of left downstream approach wall; elevation, 20.70 feet above gage datum. The gage is read twice daily by Robert D. Hoy.

Since the establishment of this station 16 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CONODOGUINET CREEK, AT BRYSON'S BRIDGE, CUMBERLAND COUNTY, PA.

(Drainage area 460 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912.							
14	Nov. 15,	Reckord & Hinkley,	218	286	1.03	2.98	295	0.6 measurement.
15	Dec. 16,	Boehringer & Reckord.	211	269	0.64	2.82	173	0.6 measurement.
	1913.							
16	April 15,	Boehringer & Reckord.	230	606	1.83	4.24	1112	0.2 and 0.8 measurement.

DISCHARGE TABLE FOR CONODOGUINET CREEK, AT BRYSON'S BRIDGE, CUMBERLAND COUNTY, FROM JAN. 1ST, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.60	127	.10	770	.60	1770	.10	3160	.60	5210
.70	155	.20	830	.70	1850	.20	3270	.70	5370
.80	185	.30	890	.80	1930	.30	3390	.80	5540
.90	217	.40	950	.90	2010	.40	3510	.90	5710
3.00	251	.50	1010	6.00	2090	.50	3640	9.00	5880
.10	287	.60	1070	.10	2170	.60	3770	.10	6060
.20	325	.70	1130	.20	2260	.70	3900	.20	6240
.30	365	.80	1200	.30	2350	.80	4030	.30	6420
.40	405	.90	1270	.40	2450	.90	4160	.40	6610
.50	450	5.00	1340	.50	2550	8.00	4300	.50	6800
.60	495	.10	1410	.60	2650	.10	4450	.60	7000
.70	545	.20	1480	.70	2750	.20	4600	.70	7200
.80	605	.30	1550	.80	2850	.30	4750	.80	7410
.90	660	.40	1620	.90	2950	.40	4900	.90	7630
4.00	715	.50	1690	7.00	3050	.50	5050	10.00	7850

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 2 low water discharge measurements, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CONODOGUINET CREEK AT BRYSON'S BRIDGE, CUMBERLAND COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	4.10	770	......	275	4.08	758	4.65	1100	4.95	1300	3.07	276	2.97	241	3.13	298	2.84	198	3.58	486	2.72	161	2.62	133
2, ...	3.92	666	......	275	3.70	545	4.48	998	4.65	1100	3.10	287	2.95	234	3.05	269	2.79	182	3.42	414	2.78	179	2.58	b122
3, ...	3.68	535	......	275	3.30	600	4.65	1100	4.27	872	3.33	377	2.93	227	3.23	337	3.54	468	3.28	357	2.78	179	2.70	155
4, ...	3.58	486	......	275	3.50	450	4.30	890	4.10	770	3.18	317	2.87	207	3.17	314	3.46	432	3.22	333	2.75	170	2.85	201
5, ...	*	325	......	275	3.30	365	3.98	699	3.93	672	2.97	241	2.95	234	3.10	287	3.26	349	3.18	317	2.68	149	2.72	161
6, ...	......	325	......	275	3.30	365	3.92	666	3.77	584	3.07	276	3.08	262	3.03	262	3.06	273	3.10	287	2.68	149	3.02	258
7, ...	......	325	......	275	3.28	357	3.88	644	3.82	611	3.15	306	3.17	314	2.95	234	3.02	258	2.98	244	2.82	191	3.42	414
8, ...	......	325	......	275	3.42	414	3.85	628	5.23	1500	3.00	251	3.03	262	2.87	207	2.92	224	2.92	224	e5.52	1710	3.23	333
9, ...	......	325	......	275	4.08	758	3.70	545	5.10	1410	3.00	251	2.97	241	3.00	251	2.86	204	2.85	201	4.30	890	3.08	280
10, ...	......	325	......	275	3.85	628	3.48	441	4.57	1050	2.93	227	2.98	244	3.60	495	2.86	204	2.95	234	3.72	556	2.90	217
11, ...	......	325	......	275	3.60	495	3.50	450	4.23	848	2.87	207	3.13	298	4.23	848	2.79	182	2.92	224	3.45	428	2.78	179
12, ...	......	325	......	275	3.50	450	3.48	441	4.38	988	2.90	217	2.97	241	4.05	740	2.74	167	2.95	234	3.28	357	2.70	155
13, ...	......	325	......	275	4.48	998	3.55	472	4.55	1040	2.83	195	2.93	227	3.75	572	2.92	224	2.88	211	3.10	287	2.65	141
14, ...	......	325	......	275	4.90	1270	3.72	556	4.72	1140	2.88	211	3.05	269	3.57	482	2.82	191	2.78	179	3.02	258	2.85	201
15, ...	......	325	......	275	6.50	2550	3.48	441	4.27	872	2.85	201	3.08	280	3.70	545	2.86	204	2.78	179	3.02	258	2.90	217
16, ...	......	325	......	275	a8.80	5540	3.65	520	4.13	788	3.13	298	3.13	298	3.47	436	3.04	265	2.68	149	2.90	217	2.95	234
17, ...	......	325	......	275	5.65	1810	3.60	495	5.25	1520	c4.38	988	4.40	950	3.27	358	3.12	295	2.65	141	2.85	201	2.75	170
18, ...	......	310	......	275	5.02	1850	5.75	1890	4.97	1820	4.75	1160	4.55	1040	3.20	325	2.69	152	2.68	149	2.72	161	2.78	179
19, ...	......	310	......	275	4.75	1160	b5.92	2080	4.50	1010	3.45	428	4.43	968	3.20	325	2.39	h80	2.70	155	2.65	141	3.10	287
20, ...	......	310	......	275	4.62	1080	5.02	1850	4.13	788	3.27	358	3.95	682	3.05	269	3.46	432	2.72	161	2.62	133	3.10	287
21, ...	......	310	......	275	4.95	1300	4.65	1100	3.98	672	3.13	298	3.27	358	3.00	251	3.16	310	2.78	179	2.68	149	3.08	280
22, ...	......	310	‡6.62	2670	5.22	1490	4.30	890	3.75	572	3.08	280	4.85	920	3.07	276	2.79	182	2.68	149	2.65	141	3.10	287
23, ...	......	310	5.50	1690	5.20	1480	4.55	1040	3.55	472	3.13	298	4.15	800	3.25	345	2.89	214	2.75	170	2.68	149	3.32	378
24, ...	......	310	4.65	1100	5.60	1770	4.18	818	3.52	459	3.12	295	3.67	530	3.57	482	3.42	414	2.62	133	2.68	149	3.05	269
25, ...	......	310	4.25	860	5.90	2010	4.02	722	3.43	418	3.13	298	3.85	628	3.23	337	d9.42	6650	2.78	179	2.65	141	3.60	495
26, ...	......	310	4.62	1080	5.30	1550	3.98	699	3.40	405	2.97	241	3.83	616	3.13	298	7.17	3240	2.75	170	2.48	h97	2.95	234
27, ...	......	310	7.32	3410	4.90	1270	4.42	962	3.30	365	3.28	357	3.65	520	3.07	276	5.33	1610	2.70	155	2.75	170	3.15	306
28, ...	......	310	5.50	1690	4.60	1070	4.75	1160	3.23	337	3.10	287	3.33	377	3.00	251	4.55	1040	2.70	155	2.58	h122	3.22	333
29, ...	......	310	4.42	962	5.32	1560	4.45	980	3.22	333	3.05	269	3.23	337	2.83	195	4.05	740	2.72	161	2.58	b122	3.28	357
30, ...	......	310	......	....	5.85	1970	5.18	1470	3.17	314	2.97	241	3.15	306	2.67	147	3.88	644	2.70	155	2.48	h97	3.25	345
31, ...	......	310	......	....	5.12	1420	......	....	3.15	306	......	....	3.30	365	2.75	170	......	....	2.78	179	......	....	f4.70	1180

Notes.—*Creek frozen over. Jan. 5 to Feb. 21, incl., discharge estimated from one ice measurement together with climatological records. ‡Creek free of ice. aMax. 9.78 at 6:35 a. m.; 7870 sec. ft. bMax. 6.23 at 7:10 a. m.; 2290 sec. ft. cMax. 4.97′ at 6:20 p. m.; 1320 sec., ft. dMax. 9.69′ at 5:45 p. m.; 7180 sec. ft. eMax. 5.94′ at 6:45 a. m.; 2040 sec. ft. fMax. 4.98′ at 4:10 p. m.; 1330 sec. ft. h=Estimated.

ESTIMATED MONTHLY DISCHARGE OF CONODOGUINET CREEK, AT BRYSON'S BRIDGE, CUMBERLAND COUNTY.

(Drainage area 460 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	356	0.774	0.892
February,	2670	....	663	1.441	1.554
March,	7870	357	1250	2.717	3.132
April,	2290	441	873	1.898	2.118
May,	1520	306	800	1.739	2.006
June,	1320	195	329	0.715	0.798
July,	1040	207	435	0.946	1.091
August,	848	147	351	0.763	0.880
September,	7180	h80	668	1.452	1.620
October,	486	133	215	0.467	0.538
November,	2040	h97	270	0.587	0.655
December,	1330	h122	282	0.613	0.707
The year,	....	....	541	1.176	15.990

Note.—h=Estimated. Creek frozen over Jan. 5th to Feb. 21st, incl., during which time one ice measurement was made, from which, in conjunction with the climatological records, the discharge for these dates was computed.

SUSQUEHANNA RIVER.

DESCRIPTION OF BASIN.

The Susquehanna river, the largest stream in the State, is formed by the junction of the North and West Branches at Northumberland, Northumberland county, Penn'a. The North Branch, together with the section below the junction of the two branches, is now recognized as the Susquehanna river, but for convenience the old nomenclature has been retained.

From Northumberland the river follows a nearly southerly course to its junction with the Juniata river near Duncannon, Perry county. at which point it cuts through the North Mountain, turning to the southeast and continuing this course to its mouth in Chesapeake Bay, at Havre-de-Grace, Md. From Northumberland to a point about 12 miles below Columbia the river is wide and shallow, averaging about one mile in width, with a slope of 2.6 feet per mile, breaking through a series of parallel ridges in the upper portion, and crossing the Cumberland Valley in the lower portion. About 23 miles above the Maryland-Pennsylvania state line the stream enters a gorge where it crosses the Piedmont Plateau and becomes a more narrow and rapid stream, with an average fall of 6.1 feet per mile, continuing this character until it leaves the State.

The prominent tributaries are the West and North Branches, Juniata river and Pennsylvania, Sherman, Conodoguinet, Swatara, Conestoga, Pequea, Conewago, Codorus and Octoraro creeks.

The total length of the Susquehanna river from Northumberland to the state boundary is 110 miles. The drainage basin of the stream in Pennsylvania is approximately 21,320 square miles, or 47.2 per cent of the entire area of the state, while the total area tributary at the Pennsylvania-Maryland state line is approximately 27,590 square miles.

The Susquehanna river is not navigable, except locally for small, flat bottom boats, adaptable for local trade and pleasure and this only during certain seasons of the year. Canals formerly followed its banks and those of the North and West Branches, Juniata river and Swatara creek, but they are now abandoned. This entire basin is largely deforested but it is to some extent in process of regrowth. The streams are subject to sudden rises and to extremely low summer flow. There are few natural lakes or ponds in the Middle and Lower Susquehanna Sub-basins.

The nearly uniform slope, which exists from Northumberland to York Haven, is broken at the latter point by rapids, and again in the gorge below Columbia. The water power on this stream at present is developed at York Haven and McCall's Ferry.

Some of the tributaries of the West Branch and Juniata river, together with Swatara, Yellow Breeches and Conodoguinet creeks drain limestone areas. The North Branch drains the anthracite coal fields, as do certain of the tributaries of the main stream, among them Mahanoy, Shamokin, Mahantonga and Wiconisco creeks.

The chief municipalities on the main river and its tributaries below Northumberland are Sunbury, Altoona, Hollidaysburg, Tyrone, Huntingdon, Lewistown, Harrisburg, Shamokin, Shenandoah, Lebanon, York, Lancaster and Columbia. The main river, both branches and many of its tributaries are followed by the Pennsylvania or the Philadelphia and Reading Railroads.

The mean annual rainfall over the entire Susquehanna basin in Pennsylvania is approximately 41 inches.

The discharge is being measured at Harrisburg, on the main stream, and at Wilkes-Barre, Danville and Binghamton, on the North Branch; Williamsport and Renovo, on the West Branch, and Newport on the Juniata river. Prior to January 1st, 1910, the discharge was obtained on the main river at McCall's Ferry. This station was discontinued, due to the erection of a large concrete dam, near the station.

SUSQUEHANNA BASIN—STATION NO. 22.

SUSQUEHANNA RIVER AT HARRISBURG.

DESCRIPTION OF STATION.

This station was established January 1st, 1891, at the pumping station of the Harrisburg Water Works, located at the foot of North Street, Harrisburg. Readings were taken on this gage until July 18th, 1904, when a standard chain gage was installed on the Walnut Street Bridge, by the U. S. Geological Survey. On July 15th, 1906, the U. S. Weather Bureau took over the maintenance of this station.

The channel is straight both above and below the station, being divided into two parts by Hargest's Island. The right and left banks are high and not subject to over flow. The bed is of gravel and boulders and is permanent.

Discharge measurements are made from the downstream side of the Walnut Street Bridge; the initial point for soundings being end post of hand-rail on downstream side at left bank.

From 1890 to July 18, 1904, the readings were taken in the pump well at the water works, the observations being made by E. Mather. On July 18th, 1904, a standard chain gage was attached to the hand-rail on the upstream side of the Walnut Street Bridge, in the first span. The length of chain from the bottom of the weight to the marker is 39.37 feet. The elevation of zero is the low water mark of 1803, or 289.4 feet above mean sea level. Bench Mark No. 1 is top of upstream outer corner of bridge seat on left abutment; elevation, 32.99 feet above gage datum. Since July 15th, 1906, the gage has been observed by E. R. Demain, Local Forecaster, U. S. Weather Bureau.

The island, which divides the river into two channels at this point, only overflows at extreme high stages.

Since the establishment of this station 56 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF SUSQUEHANNA RIVER, AT HARRISBURG, DAUPHIN COUNTY, PA.

(Drainage area 23,865 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913.							
56	Mar. 28,	Langenheim & Reckord.	2724	56228	7.42	19.46	416,984	Surface measurement.

DISCHARGE TABLE FOR SUSQUEHANNA RIVER AT HARRISBURG, DAUPHIN COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
—0.04	2330	.10	53400	.40	154570	.70	289000	21.00	456500
- 0.02	2360	.20	55020	.50	156740	.80	291800	.10	460100
0.00	2395	.30	56660	.60	158920	.90	294600	.20	463800
.10	2610	.40	58320	.70	161110	16.00	297400	.30	467600
.20	2895	.50	60000	.80	163320	.10	300300	.40	471400
.30	3220	.60	61700	.90	165550	.20	303200	.50	475200
.40	3590	.70	63410	11.00	167800	.30	306100	.60	479000
.50	3995	.80	65130	.10	170100	.40	309000	.70	482800
.60	4435	.90	66860	.20	172400	.50	311900	.80	486600
.70	4905	6.00	68600	.30	174700	.60	314800	.90	490400
.80	5410	.10	70350	.40	177000	.70	317700	22.00	494200
.90	5930	.20	72110	.50	179400	.80	320600	.10	498100
1.00	6475	.30	73870	.60	181800	.90	323500	.20	502000
.10	7035	.40	75630	.70	184200	17.00	326400	.30	505900
.20	7625	.50	77400	.80	186600	.10	329400	.40	509900
.30	8230	.60	79200	.90	189000	.20	332400	.50	513900
.40	8900	.70	81020	12.00	191400	.30	335400	.60	518000
.50	9610	.80	82860	.10	193800	.40	338400	.70	522100
.60	10380	.90	84720	.20	196200	.50	341500	.80	526200
.70	11180	7.00	86600	.30	198700	.60	344600	.90	530300
.80	12000	.10	88500	.40	201200	.70	347700	23.00	534400
.90	12835	.20	90400	.50	203700	.80	350800	.10	538500
2.00	13690	.30	92300	.60	206200	.90	353900	.20	542600
.10	14550	.40	94200	.70	208700	18.00	357000	.30	546700
.20	15410	.50	96100	.80	211200	.10	360200	.40	550900
.30	16290	.60	98040	.90	213800	.20	363400	.50	555100
.40	17180	.70	99980	13.00	216400	.30	366600	.60	559300
.50	18100	.80	101920	.10	219000	.40	369800	.70	563500
.60	19030	.90	103860	.20	221600	.50	373000	.80	567700
.70	19980	8.00	105800	.30	224200	.60	376200	.90	571900
.80	20950	.10	107770	.40	226800	.70	379400	24.00	576200
.90	21960	.20	109740	.50	229400	.80	382600	.10	580500
3.00	23000	.30	111710	.60	232000	.90	385800	.20	584800
.10	24150	.40	113680	.70	234600	19.00	389000	.30	589100
.20	25450	.50	115670	.80	237200	.10	392300	.40	593400
.30	26800	.60	117650	.90	239800	.20	395600	.50	597700
.40	28150	.70	119650	14.00	242400	.30	398900	.60	602000
.50	29500	.80	121650	.10	245100	.40	402200	.70	606400
.60	30900	.90	123650	.20	247800	.50	405500	.80	610900
.70	32300	9.00	125650	.30	250500	.60	408800	.90	615400
.80	33750	.10	127660	.40	253200	.70	412100	25.00	620000
.90	35200	.20	129670	.50	255900	.80	415400	.10	624700
4.00	36600	.30	131680	.60	258600	.90	418700	.20	629400
.10	38050	.40	133690	.70	261300	20.00	422000	.30	634100
.20	39500	.50	135700	.80	264000	.10	425400	.40	638800
.30	41000	.60	137720	.90	266700	.20	428800	.50	643500
.40	42550	.70	139760	15.00	269400	.30	432200	.60	648300
.50	44100	.80	141820	.10	272200	.40	435600	.70	653100
.60	45650	.90	143900	.20	275000	.50	439000	.80	658000
.70	47200	10.00	146000	.30	277800	.60	442500	.90	662900
.80	48750	.10	148120	.40	280600	.70	446000	26.00	667800
.90	50250	.20	150260	.50	283400	.80	449500		
5.00	51800	.30	152410	.60	286200	.90	453000		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on two discharge measurements made during 1912-13, together with the former curve, and only affects discharge above eleven feet.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SUSQUEHANNA RIVER AT HARRISBURG, DAUPHIN COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	4.40	42600	......	14000	6.00	68600	12.53	204000	6.71	81200	2.56	18700	1.13	7210	1.82	8360	1.65	10800	4.47	43600	3.35	27500	2.72	20200
2, ...	4.08	37800	......	14000	4.98	51500	11.46	178000	8.44	114000	2.48	17900	1.11	7090	1.25	7930	1.65	10800	4.22	39800	3.11	24300	2.65	19500
3, ...	4.05	37300	......	14000	4.50	44100	12.68	208000	7.30	92300	2.87	21700	1.08	6920	1.11	7090	1.88	12700	3.97	36200	3.04	23500	2.78	20800
4, ...	3.69	32200	......	14000	4.00	36600	14.13	246000	6.27	73300	2.69	19900	1.05	6760	1.07	6870	2.37	16900	3.65	31600	2.92	22200	4.00	36600
5, ...	3.54	30100	......	14000	3.46	29000	11.55	181000	5.59	61500	2.47	17800	1.07	6870	1.00	6480	4.67	46700	3.40	28200	2.76	20600	5.49	59800
6, ...	3.00	23000	......	14000	3.08	23900	9.31	132000	4.96	51200	2.36	16800	1.02	6590	0.98	6370	4.72	47500	3.16	24900	2.64	19400	5.77	64600
7, ...	2.88	21800	......	14000	3.00	23000	8.09	108000	4.64	46300	2.48	17900	1.16	7890	0.93	6090	3.95	37900	2.88	21800	2.62	19200	5.66	62700
8, ...	2.54	18500	......	14000	2.83	21300	8.44	114000	5.11	53600	2.36	16800	1.06	6810	0.88	5830	3.71	32400	2.63	19300	4.30	41000	5.87	66300
9, ...	*	18000	......	14000	3.16	24900	9.02	126000	5.69	63200	2.19	15300	1.01	6530	0.93	6090	3.09	24000	2.44	17500	6.07	69800	6.05	69500
10, ...	......	18000	......	14000	3.63	31300	8.87	123000	5.88	66500	2.00	13700	1.00	6480	1.11	7090	2.61	19100	2.33	16600	6.35	74800	5.43	58800
11.	......	18000	......	14000	3.97	36200	7.79	102000	5.85	66000	1.88	12700	1.01	6530	1.43	9110	2.29	16200	2.26	15900	6.25	73000	4.78	48400
12, ...	......	18000	......	14000	3.92	35500	6.81	83000	5.50	60000	1.81	12100	0.99	6420	2.42	17400	2.06	14200	2.31	16400	5.45	59200	4.20	39500
13, ...	......	18000	......	14000	4.19	39400	6.12	70700	5.97	68100	1.73	11400	1.15	7330	2.10	14600	1.86	12500	2.33	16600	4.84	49400	‡3.64	31500
14, ...	......	18000	......	14000	5.05	52600	5.85	66000	6.65	80100	1.64	10700	0.99	6420	1.88	12700	1.71	11300	2.50	18100	4.42	42900	‡3.21	25600
15, ...	......	18000	......	14000	5.67	62900	5.96	67900	5.99	68400	1.60	10400	0.98	6370	1.86	12500	1.69	11100	2.55	18600	4.12	38300	3.44	28700
16, ...	......	18000	......	14000	10.20	150000	5.89	66700	5.49	59800	1.58	10200	1.03	6640	1.78	11400	1.74	11500	2.35	16700	3.87	34800	3.04	23500
17, ...	......	18000	......	14000	11.77	186000	6.37	75100	5.75	64300	1.74	11500	1.15	7380	1.56	10100	1.77	11800	2.31	16400	3.66	31700	2.92	22200
18, ...	......	18000	......	14000	10.34	153000	7.63	98600	8.19	110000	2.32	16500	1.40	8900	1.50	9610	1.69	11100	2.14	14900	3.46	29000	2.92	22200
19, ...	......	18000	......	14000	10.01	146000	8.26	111000	8.49	115000	2.36	16800	1.52	9760	1.36	8630	1.72	11300	2.11	14600	3.28	26500	2.94	22400
20, ...	......	18000	......	14000	10.30	152000	7.95	105000	7.01	86800	2.03	13900	1.46	9330	1.38	8770	2.42	17400	2.04	14600	3.12	24400	3.20	25400
21, ...	......	17000	......	14000	10.38	154000	7.83	92900	6.02	69000	2.04	14000	1.73	11400	1.77	11800	2.29	16200	1.98	13500	2.98	22800	3.41	28300
22, ...	......	17000	......	20000	10.07	147000	6.48	77000	5.29	56500	1.84	12300	2.15	15000	1.93	13100	2.18	15200	1.94	13200	2.87	21700	3.46	29000
23, ...	......	17000	......	20000	9.03	126000	5.76	64400	4.68	46900	1.63	10600	2.50	18100	1.76	11700	2.10	14600	2.04	14000	2.77	20700	3.65	31600
24, ...	......	17000	......	20000	7.97	105000	5.57	61200	4.23	40000	1.51	9690	2.50	18100	1.73	11400	2.21	15500	2.04	14000	2.69	19900	3.38	27900
25, ...	......	17000	......	20000	7.20	90400	5.17	54500	3.91	35300	1.57	10100	1.96	13300	1.74	11500	4.74	47800	2.35	16700	2.70	20000	3.09	24000
26, ...	......	17000	......	20000	7.05	87600	5.18	54700	3.68	32000	1.43	9110	2.04	14000	1.65	10800	8.96	125000	3.59	30800	2.89	21900	2.82	21200
27, ...	......	17000	†8.50	116000	6.76	82100	4.95	51000	3.35	27500	1.36	8630	2.21	15500	1.60	10400	7.86	103000	3.93	35600	2.82	21200	2.74	20400
28.	......	17000	a9.56	137000	6.76	82100	4.77	48800	3.10	24200	1.32	8360	1.88	12700	1.63	10600	6.41	75800	5.08	53100	2.81	21100	2.70	20000
29, ...	......	17000	7.43	94800	7.68	99600	4.54	44700	2.97	22700	1.25	7930	1.63	10600	1.54	9920	5.64	62400	4.57	45200	2.80	21000	2.66	19600
30, ...	......	17000	......	......	11.41	177000	4.88	50000	2.83	21300	1.23	7810	1.52	9760	1.53	9840	4.97	51300	4.07	37600	2.81	21100	2.72	20200
31, ...	......	17000	......	......	13.85	238000	......	......	2.68	19300	....	......	1.37	8700	1.71	11300	....	......	3.67	31900	....	......	2.97	22700

Notes.—*River frozen Jan. 9 to Feb. 26, incl., daily discharge estimated from a comparison with West Br. Susquehanna River at Williamsport and North Branch Susquehanna River at Wilkes-Barre. †Ice went out at 11:50 a. m. aMax. 11.00 at 12:00 noon; 168000 sec. ft. ‡River running full of thin ice.

ESTIMATED MONTHLY DISCHARGE OF SUSQUEHANNA RIVER, AT HARRISBURG, DAUPHIN COUNTY.

(Drainage area 23,885 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	20800	0.871	1.004
February,	168000	....	25600	1.072	1.156
March,	238000	21300	88900	3.722	4.291
April,	246000	44700	102000	4.270	4.764
May,	115000	19800	60600	2.533	2.920
June,	21700	7810	13400	0.561	0.626
July,	18100	6370	9380	0.393	0.453
August,	17400	5830	9850	0.412	0.475
September,	125000	10800	30400	1.273	1.420
October,	53100	13200	24100	1.009	1.163
November,	74800	19200	32100	1.344	1.499
December,	69500	19500	33800	1.394	1.607
The year,	....	....	37500	1.571	21.378

Note.—River frozen Jan. 9 to Feb. 26, incl., daily discharge estimated from a comparison with West Br. Susquehanna River at Williamsport and North Br. Susquehanna River at Wilkes-Barre.

YELLOW BREECHES CREEK.

DESCRIPTION OF BASIN.

Yellow Breeches creek, a tributary of the lower Susquehanna river, drains an area of approximately 225 square miles. Rising in the southwestern corner of Cumberland county, it follows a northeasterly direction through the rich, agricultural region of the Cumberland Valley, to its mouth in the Susquehanna river at New Cumberland, the total length being approximately 50 miles. Its course is winding, particularly near its mouth, and its slope becomes less rapid as the river is approached. There are numerous small tributaries rising in the well timbered, sandstone hills, which parallel the entire watershed on the south. The creek follows closely, throughout its long and narrow watershed, the foot of these hills, while on the north the valley is wide and rolling, being underlain with limestone and producing numerous copious springs, notably Boiling Springs, which are by far the largest in the State, maintaining a continuous flow of over 20,000,000 gallons per 24 hours. In the entire valley there are, owing to the presence of this limestone area, only a few small tributaries entering from the north. In the drainage basin lie many small villages, several of which obtain water supplies from the creek and its tributaries. Yellow Breeches creek is used quite extensively by grist mills for power purposes and its dry weather flow, maintained by the limestone springs, is remarkably large.

The mean annual precipitation over the greater portion of this watershed is from 35 to 40 inches, the balance receiving from 40 to 45 inches.

The discharge has been measured since March 22, 1909, at Olmsted's Mill, three miles above the mouth.

SUSQUEHANNA BASIN—STATION NO. 23.

YELLOW BREECHES CREEK AT OLMSTED'S MILL.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on March 22nd, 1909, at a single span, through truss, steel, highway bridge, just below Lambert's Mill, about one mile south of White Hill Station on the Cumberland Valley Railroad. It was discontinued on October 31st, 1909, and re-established January 22nd, 1910.

The channel above the station is straight for 200 feet to a wooden mill dam four feet high, while below the station the channel is straight for 75 feet, when there is a sharp bend to the right. Both banks are high and do not overflow. The bed of the creek is fairly permanent, and there is but one channel at all stages. Water runs over the dam continuously.

Discharge measurements are taken from the downstream side of the bridge, the initial point for soundings being the downstream side of the top edge of the bridge seat of the left abutment.

A standard chain gage is bolted to the bottom chord eyebar in the fourth panel from the right abutment, downstream side. The length of chain from the bottom of weight to the marker is 15.06 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is top of bridge seat, right abutment, outer downstream corner; elevation 13.62 feet above zero of gage. The gage is read twice daily by B. G. Lambert.

This stream has a remarkably high dry weather flow, on account of the limestone springs on its watershed.

Since the establishment of this station 23 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF YELLOW BREECHES CREEK, AT OLMSTEDS MILL, CUMBERLAND COUNTY, PA.

(Drainage area 223 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
23	1912. Dec. 16,	Boehringer & Reckord.	124	231	0.62	0.90	144	0.6 measurement.

DISCHARGE TABLE FOR YELLOW BREECHES CREEK, AT OLMSTEDS MILL, CUMBERLAND COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.50	130	.10	555	.70	1305	.30	2265	.90	3650
.60	135	.20	595	.80	1360	.40	2335	7.00	3750
.70	145	.30	640	.90	1415	.50	2405	.10	3850
.80	155	.40	685	4.00	1470	.60	2480	.20	3950
.90	170	.50	730	.10	1525	.70	2560	.30	4055
1.00	185	.60	775	.20	1580	.80	2640	.40	4160
.10	205	.70	820	.30	1635	.90	2725	.50	4270
.20	230	.80	865	.40	1695	6.00	2815	.60	4380
.30	255	.90	910	.50	1755	.10	2905	.70	4495
.40	285	3.00	955	.60	1815	.20	2995	.80	4610
.50	320	.10	1005	.70	1875	.30	3085	.90	4730
.60	355	.20	1055	.80	1935	.40	3175	8.00	4850
.70	395	.30	1105	.90	1995	.50	3270		
.80	435	.40	1155	5.00	2060	.60	3365		
.90	475	.50	1205	.10	2125	.70	3460		
2.00	515	.60	1255	.20	2195	.80	3555		

Note.—This rating table is only applicable subsequent to Jan. 1, 1912, and is based on two discharge measurements made during 1912, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF YELLOW BREECHES CREEK AT OLMSTEDS MILL, CUMBERLAND COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	1.58	348	1.10	205	1.90	475	2.05	585	2.90	910	1.08	201	1.00	185	0.89	168	0.74	149	1.04	193	0.81	156	1.10	205
2, ...	1.51	324	1.08	201	1.82	443	1.97	503	1.87	463	1.08	201	1.00	185	0.87	166	0.76	151	1.00	185	0.80	155	1.15	218
3, ...	1.46	306	1.04	193	1.38	279	1.99	511	1.82	443	1.98	507	0.96	179	0.94	176	0.92	173	0.98	182	0.80	155	1.19	228
4, ...	1.46	306	1.02	189	1.31	258	2.00	515	1.80	435	1.81	439	0.92	173	0.82	158	0.89	168	0.97	180	0.80	155	1.18	225
5, ...	1.46	306	1.02	189	1.34	267	1.81	439	1.76	419	1.78	427	1.50	320	0.83	160	0.86	164	0.92	173	0.78	153	1.18	225
6, ...	1.44	299	1.01	187	1.30	255	1.80	435	1.75	415	1.56	341	1.40	285	0.86	164	0.84	161	0.88	167	0.78	153	1.19	228
7, ...	1.43	296	1.02	189	1.34	267	1.94	491	1.76	419	1.50	320	0.94	176	0.82	158	0.88	167	0.88	167	1.05	195	1.18	225
8, ...	1.42	292	1.00	185	1.40	285	1.92	483	1.94	491	1.45	302	0.90	170	0.80	155	1.16	220	0.86	164	1.80	435	1.18	225
9, ...	1.42	292	0.95	178	1.42	292	1.76	419	2.04	531	1.26	245	0.86	164	0.80	155	0.98	182	0.88	167	1.60	355	1.17	222
10, ...	1.41	288	0.92	173	1.38	279	1.76	419	1.96	499	1.14	215	0.85	162	1.26	245	0.81	156	0.90	170	1.56	341	1.16	220
11, ...	1.40	285	0.90	170	1.30	255	1.63	367	1.86	459	1.10	205	0.86	164	2.33	654	0.80	155	0.90	170	1.38	279	1.16	220
12, ...	1.30	255	1.00	185	2.06	539	1.60	355	1.76	419	1.06	197	0.90	170	2.06	539	0.75	150	0.90	170	1.20	230	1.15	218
13, ...	1.26	245	0.98	182	2.84	833	1.61	359	1.86	459	1.03	191	0.90	170	c2.24	613	0.72	147	0.94	176	1.19	228	1.16	220
14, ...	1.12	210	0.98	182	2.18	587	1.66	379	1.76	419	1.00	185	0.90	170	1.94	491	0.72	147	0.94	176	1.20	230	1.08	201
15, ...	1.11	208	0.99	184	b4.96	2080	1.64	371	1.70	395	0.90	170	0.88	167	1.85	455	0.71	146	0.86	164	1.18	225	0.94	176
16, ...	1.10	205	1.02	189	4.00	1470	1.63	367	1.81	439	1.10	205	0.84	161	1.80	435	0.72	147	0.82	158	1.18	225	0.86	164
17, ...	1.11	208	1.08	201	2.56	757	2.02	523	1.91	479	2.05	535	0.83	160	1.80	435	0.70	145	0.80	155	1.18	225	0.80	155
18, ...	1.04	193	1.11	208	2.46	712	2.40	685	1.84	451	1.91	479	0.94	176	1.76	419	0.70	145	0.78	153	1.17	222	0.81	156
19, ...	1.05	195	1.00	185	2.40	685	1.84	451	1.80	435	1.78	427	0.95	178	1.40	285	0.70	145	0.78	153	1.16	220	1.21	232
20, ...	1.12	210	1.02	189	2.41	690	1.62	363	1.76	419	1.70	395	0.94	176	0.98	182	0.74	149	0.81	156	1.14	215	1.19	228
21, ...	1.10	205	1.36	273	2.30	640	1.50	320	1.70	395	1.10	205	0.98	182	0.84	161	0.74	149	0.79	154	1.10	205	1.18	225
22, ...	1.10	205	a4.10	1520	2.27	626	1.51	324	1.56	341	1.06	197	1.38	279	0.81	156	0.78	158	0.74	149	1.08	201	1.17	222
23, ...	1.06	197	1.94	491	2.25	618	1.76	419	1.50	320	0.98	182	1.36	273	1.31	258	0.82	158	0.79	154	1.10	205	1.14	215
24, ...	1.04	193	1.28	250	2.10	555	1.62	363	1.42	292	1.06	197	1.89	467	0.98	182	1.58	348	0.80	155	1.16	220	1.15	218
25, ...	1.06	197	1.20	230	3.10	1000	1.70	395	1.36	273	1.20	230	1.95	495	0.88	167	2.75	842	0.80	155	1.16	220	1.10	205
26, ...	1.08	191	1.78	427	2.60	775	1.66	379	1.29	252	1.14	215	1.92	483	0.86	164	2.00	515	0.81	156	1.15	218	*0.92	173
27, ...	1.04	193	4.38	1680	2.20	595	1.89	471	1.27	248	1.09	208	1.96	499	0.85	162	1.91	479	0.82	158	1.14	215	0.86	164
28, ...	1.04	193	2.08	547	2.00	515	2.18	587	1.20	230	1.06	197	1.92	483	0.88	167	1.90	475	0.80	155	1.15	218	†1.06	197
29, ...	1.04	193	1.98	507	3.01	960	2.16	579	1.17	222	1.05	195	1.55	338	0.84	161	1.45	302	0.80	155	1.14	215	0.98	182
30, ...	1.02	189	......	....	2.43	694	2.98	946	1.10	205	1.00	185	1.46	306	0.80	155	1.06	197	0.80	155	1.12	210	0.92	173
31, ...	1.02	189	......	....	2.28	681	......	....	1.10	205	......	....	0.95	178	0.76	151	......	....	0.80	155	......	....	1.92	483

Note.—aMax. 5.69 at 7:00 a. m.; 2550 sec-ft. bMax. 6.80 at 5:00 p. m.; 3560 sec-ft. cMax. 3.05 at 6:00 p. m.; 980 sec.ft. *Creek frozen over. †Break in ice.

ESTIMATED MONTHLY DISCHARGE OF YELLOW BREECHES CREEK, AT OLMSTEDS MILL, CUMBERLAND COUNTY, PA.

(Drainage area 223 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	348	189	239	1.072	1.236
February,	2550	170	334	1.498	1.616
March,	3560	255	623	2.794	3.221
April,	946	320	458	2.054	2.291
May,	910	205	399	1.789	2.063
June,	535	170	273	1.224	1.365
July,	499	160	248	1.112	1.282
August,	980	151	261	1.170	1.349
September,	842	145	226	1.013	1.130
October,	193	149	164	0.735	0.848
November,	435	153	223	1.000	1.116
December,	483	155	214	0.960	1.107
The year,	3560	145	305	1.368	18.624

BIG SWATARA CREEK.

DESCRIPTION OF BASIN.

Big Swatara creek, a tributary of the Susquehanna river from Schuylkill, Berks, Lebanon and Dauphin counties, drains an approximate area of 565 square miles. Rising in the hills in the southwestern part of Schuylkill county, this stream flows in a general southwesterly direction through a broad, rolling, farming country, well inhabited and largely deforested, to its mouth at Middletown, Dauphin county, a distance of about 65 miles. On the headwaters in Schuylkill county lie numerous anthracite coal mines, the culm from which pollutes the entire stream. There are numerous tributaries, the principal being Little Swatara and Quittapahilla creeks. The sub-basins of some of the tributaries are underlain with limestone and numerous strong springs contribute to its flow. The slope is flat and the flow sluggish in the lower portion. The city of Lebanon and numerous large boroughs and villages lie on the watershed. The main stream and its branches are used to some extent for domestic and industrial supply, while numerous mill and power dams cause slack water for long stretches.

The upper part of the watershed is subject to a mean annual precipitation of from 40 to 50 inches and the lower portion from 40 to 45 inches.

The discharge has been measured at Jonestown, just above the mouth of Little Swatara creek, since November 19, 1910.

SUSQUEHANNA BASIN—STATION NO. 24.

BIG SWATARA CREEK AT JONESTOWN.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, in co-operation with the Lebanon Valley Consolidated Water Supply Company, on November 19th, 1910, at a two span, steel, through truss, highway bridge, between Jonestown proper and the Philadelphia and Reading Railway Station.

For 150 feet above and 200 feet below the station, the channel is straight, with a rift above and pool below. Both banks are low, but the water passes under the bridge at all stages. The bed is composed of gravel, sand and culm. At low stages the velocity under the bridge is slight.

Discharge measurements are taken from the downstream side of the bridge, or by wading during low water. The initial point for soundings is right face of first hand-rail post on left side of bridge. The stations are painted on the downstream truss.

A chain gage, with removable weight and chain, is attached to the floor on the downstream side of the bridge. The length of chain from bottom of weight to marker is 23.02 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is niche cut in top of corner stone on 16th tier from top of left abutment, downstream face; elevation, 8.49 feet above gage datum. The gage is read twice daily by the watchman at the filter plant of the Lebanon Valley Consolidated Water Supply Company.

There is a mill dam about six miles above which stores water at night.

Little Swatara creek joins the main stream about one mile below the gaging station.

Since the establishment of this station 19 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BIG SWATARA CREEK, AT JONESTOWN, LEBANON COUNTY, PA.

(Drainage area 190 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912.							
17	Dec. 10,	Reckord, ...	179	315	1.22	3.94	383	Surface measurement.
	1913.							
18	Mar. 27,	Hinkley, ...	226	1860	4.43	11.31	8239	Surface measurement.
19	Mar. 27,	Hinkley, ...	226	1888	4.59	11.47	8672	Surface measurement.

DISCHARGE TABLE FOR BIG SWATARA CREEK, AT JONESTOWN, LEBANON COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
3.00	10	.30	565	.60	1660	.90	3114	.20	4674
.10	30	.40	630	.70	1770	7.00	3230	.30	4796
.20	60	.50	695	.80	1880	.10	3350	.40	4918
.30	90	.60	765	.90	1990	.20	3470	.50	5040
.40	125	.70	840	6.00	2100	.30	3590	.60	5162
.50	160	.80	915	.10	2210	.40	3710	.70	5284
.60	200	.90	995	.20	2320	.50	3830	.80	5406
.70	245	5.00	1080	.30	2430	.60	3950	.90	5528
.80	290	.10	1170	.40	2540	.70	4070	9.00	5650
.90	335	.20	1260	.50	2650	.80	4190		
4.00	385	.30	1360	.60	2766	.90	4310		
.10	440	.40	1460	.70	2882	8.00	4430		
.20	500	.50	1560	.80	2998	.10	4552		

Note.—This rating table is only applicable subsequent to Jan. 1, 1912, and is based on two high water discharge measurements made during 1913, together with former curve; the change having affected former tables above 7 ft.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF BIG SWATARA CREEK AT JONESTOWN, LEBANON COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1,	4.00	385	......	120	4.12	452	4.87	971	4.35	598	3.43	136	3.25	75	3.27	81	3.11	33	3.86	317	3.52	168	3.49	156
2,	3.92	345	......	120	3.87	322	4.78	900	4.36	604	3.42	132	3.13	39	3.25	75	3.42	132	3.73	258	3.77	276	3.66	227
3,	3.95	360	......	120	3.92	345	5.15	1220	4.17	482	4.01	390	3.09	28	3.29	87	3.39	122	3.63	214	3.58	192	3.49	156
4,	3.91	340	......	120	3.87	322	5.52	1580	4.11	446	3.62	209	3.08	26	3.25	75	3.29	87	3.61	204	3.49	156	4.31	572
5,	3.65	222	......	120	3.81	294	4.43	650	4.01	390	3.42	182	3.17	51	3.16	43	3.23	69	3.56	184	3.47	150	4.01	390
6,	*	135	......	120	3.63	214	4.41	636	4.07	424	3.62	209	3.26	78	3.17	51	3.23	69	3.47	150	3.46	146	4.55	780
7,	......	135	......	120	3.78	281	4.32	578	4.07	424	3.82	299	3.11	33	3.13	39	3.31	94	3.45	142	4.28	539	4.35	598
8,	......	135	......	120	3.95	360	4.48	682	4.82	931	3.47	150	3.09	28	3.11	33	3.27	81	3.43	136	5.09	1160	4.16	476
9,	......	135	......	120	4.11	446	4.16	476	4.41	636	3.42	132	3.07	24	3.15	45	3.19	57	3.36	111	4.48	682	4.03	402
10,	......	135	......	120	3.95	360	4.11	446	4.27	546	3.37	114	3.03	16	3.62	209	3.13	39	3.46	146	4.25	532	3.92	345
11,	......	135	......	120	3.87	322	4.05	412	4.17	482	3.36	111	3.07	24	4.08	429	3.12	36	4.02	396	4.12	452	3.87	322
12,	......	135	......	120	3.69	240	3.96	365	4.43	650	3.31	94	3.22	66	3.46	146	3.11	33	3.75	268	4.03	402	3.78	281
13,	......	135	......	120	5.91	2000	3.96	365	4.57	744	3.41	128	3.26	78	3.37	114	3.09	28	3.48	153	3.89	330	3.65	222
14,	......	135	......	120	4.52	709	4.05	412	4.26	539	3.28	84	3.19	57	3.42	132	3.08	26	3.42	132	3.85	312	3.56	184
15,	......	135	......	120	a8.77	5370	3.91	340	4.18	488	3.32	97	3.17	51	3.35	108	3.07	24	3.39	132	3.77	276	3.66	227
16,	......	135	......	120	6.98	3210	4.02	396	4.43	650	3.47	150	3.17	51	3.26	78	4.05	412	3.37	114	3.71	250	3.65	222
17,	......	135	......	120	5.49	1550	4.23	520	4.67	818	3.51	164	3.72	254	3.21	63	3.56	184	3.35	108	3.65	222	3.59	196
18,	......	130	......	120	5.16	1220	6.09	2200	4.33	584	3.33	100	4.18	458	3.18	54	3.41	128	3.33	100	3.58	192	3.58	192
19,	......	130	......	120	4.88	979	5.65	1720	4.19	494	3.26	78	3.43	136	3.22	66	3.39	123	3.33	100	3.53	172	4.71	848
20,	......	130	......	120	4.95	1040	4.96	1050	4.11	446	3.22	66	3.31	94	3.22	66	3.41	128	3.35	108	3.56	184	4.23	520
21,	......	130	†4.84	947	4.77	892	4.65	802	3.99	380	3.21	63	3.32	97	3.22	66	3.35	108	3.36	111	3.48	153	4.02	396
22,	......	130	5.94	2080	4.59	758	4.58	716	3.91	340	3.18	54	4.46	669	3.26	78	3.27	81	3.71	260	3.48	153	3.96	365
23,	......	130	4.44	656	4.56	737	4.65	802	3.89	330	3.18	54	3.72	254	3.26	78	3.28	84	4.37	610	3.46	146	3.89	330
24,	......	130	4.23	513	4.95	1040	4.29	558	3.82	299	3.22	66	3.55	180	3.28	84	3.98	375	4.27	546	3.83	304	3.96	365
25,	......	130	4.12	452	4.97	1050	4.18	488	3.73	258	3.28	84	3.52	168	3.23	69	b5.81	1890	4.31	572	3.98	375	3.89	330
26,	......	130	4.31	572	4.79	908	4.05	412	3.71	250	3.26	78	3.45	142	3.21	63	5.01	1090	4.29	558	3.71	250	3.76	272
27,	......	130	6.08	2190	4.67	818	4.28	552	3.68	236	3.26	78	3.41	128	3.18	54	4.72	855	4.01	390	3.59	196	4.05	412
28,	......	130	4.68	825	4.78	900	4.18	488	3.61	204	3.21	63	3.38	118	3.16	48	4.58	751	3.77	276	3.58	192	4.12	452
29,	......	130	4.34	591	6.41	2550	4.23	520	3.61	204	3.18	54	3.26	78	3.16	48	4.03	402	3.69	240	3.53	172	3.83	304
30,	......	130	......	....	5.86	1950	4.62	780	3.59	196	3.26	78	3.23	69	3.16	48	3.91	340	3.63	214	3.48	153	4.49	688
31,	......	130	......	....	5.17	1230	......	....	3.49	156	......	....	3.21	63	3.11	33	......	....	3.57	188	......	....	5.62	1680

*Stream frozen. Daily discharge from Jan. 6-Feb. 20, incl., estimated from Conodoguinet Creek at Brysons Bridge and Lackawanna River at Scranton. †Ice went out. aMax. 10.25 at 6:00 p. m.; 7180 sec-ft. bMax. 6.87 at 6:00 a. m.; 3060 sec-ft.

ESTIMATED MONTHLY DISCHARGE OF BIG SWATARA CREEK, AT JONESTOWN, LEBANON COUNTY.

(Drainage area 190 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	164	0.863	0.995
February,	2190	....	385	2.026	2.185
March,	7180	214	1060	5.579	6.432
April,	2200	340	735	3.868	4.316
May,	931	156	459	2.416	2.785
June,	390	54	122	0.642	0.716
July,	669	16	117	0.616	0.710
August,	429	33	86	0.453	0.522
September,	3060	24	263	1.384	1.544
October,	610	100	239	1.258	1.451
November,	1160	146	296	1.558	1.738
December,	1680	156	415	2.184	2.518
The year,	....	....	362	1.904	25.912

Note.—Stream frozen Jan. 6-Feb. 20, incl., daily discharge estimated from Conodoguinet Creek at Brysons Bridge and Lackawanna River at Scranton.

POTOMAC BASIN

GAGING STATIONS IN POTOMAC BASIN.

No.	Stream.	Location.	Established.	Discontinued.	Re-established.	1912 Information Available.
1	West Branch Little Antietam creek,	Mont Alto, Pa.,	May 1, 1909,			Discharge complete.
2	Monacacy river,	Frederick, Md.,	August 4, 1896,			Discharge complete.

WEST BRANCH OF LITTLE ANTIETAM CREEK.

DESCRIPTION OF BASIN.

The West Branch of Little Antietam creek rises in many springs and mountain streams in Quincy township, Franklin county, and flows in a general southerly direction to its junction with the East Branch, about onehalf mile below the State Line in Maryland. Its drainage area in Pennsylvania is 44 square miles, while its total length is approximately 12 miles. Its course is through an agricultural region, the hills bordering the valley being heavily timbered. There are but few tributaries; those entering from the west draining a limestone area. In its watershed are many small towns and villages, the largest of which is Waynesboro, which receives part of its domestic water supply from the creek.

The mean annual precipitation over this watershed is from 35 to 40 inches.

The discharge of this stream has been measured over a concrete weir since May 1st, 1909, at Mont Alto, by the Pennsylvania State Forestry Academy, about 2 miles below its source.

POTOMAC BASIN—STATION NO. 1.

WEST BRANCH OF LITTLE ANTIETAM CREEK AT MONT ALTO, PA.

DESCRIPTION OF STATION.

This station was established by the Pennsylvania State Forestry Academy on May 1st, 1909, and consists of a concrete weir located about one mile above the Academy Buildings, on State land. This weir is of the sharp crested type with end contractions, being 5.98 feet wide across the crest at the bottom and 6.05 feet wide at the top. The sides are 1.64 feet high and the crest is not level, the west end being 0.01 of a foot lower than the right. The hook gage is placed about three feet up stream from the right end and is read to thousandths. Floods overflow the weir but once or twice yearly, the ordinary high water being about 1.5 feet over the crest. To all appearances there is no leakage through the concrete or under it.

The weir is read on an average of twice daily by the Forestry Academy students, except during vacation periods.

Water is pumped from the stream above the weir by the system which supplies the State Health Department, Mont Alto Sanitarium, and is also lead by a 6inch pipe from a point a short distance above the weir to the Academy buildings. No records are obtainable of the amount thus used by the latter supply, but the supply pumped to the Sanitarium averaged 31,100 gallons per day, during the year 1912, or at the rate of 0.048 cubic feet per second.

The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE TABLE FOR WEST BRANCH LITTLE ANTIETAM CREEK, AT MONT ALTO, FRANKLIN COUNTY, FROM MAY 1, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.00	0.00	0.31	3.39	0.62	9.53	0.93	17.38	1.24	26.54
0.01	0.05	0.32	3.56	0.63	9.77	0.94	17.65	1.25	26.85
0.02	0.10	0.33	3.73	0.64	10.01	0.95	17.93	1.26	27.16
0.03	0.15	0.34	3.90	0.65	10.25	0.96	18.21	1.27	27.47
0.04	0.20	0.35	4.07	0.66	10.49	0.97	18.49	1.28	27.78
0.05	0.26	0.36	4.24	0.67	10.73	0.98	18.77	1.29	28.09
0.06	0.32	0.37	4.42	0.68	10.97	0.99	19.05	1.30	28.41
0.07	0.39	0.38	4.60	0.69	11.21	1.00	19.33	1.31	28.73
0.08	0.46	0.39	4.78	0.70	11.45	1.01	19.62	1.32	29.05
0.09	0.54	0.40	4.96	0.71	11.69	1.02	19.91	1.33	29.38
0.10	0.63	0.41	5.14	0.72	11.94	1.03	20.20	1.34	29.71
0.11	0.72	0.42	5.33	0.73	12.19	1.04	20.49	1.35	30.04
0.12	0.82	0.43	5.52	0.74	12.44	1.05	20.78	1.36	30.37
0.13	0.92	0.44	5.71	0.75	12.69	1.06	21.07	1.37	30.70
0.14	1.03	0.45	5.90	0.76	12.94	1.07	21.36	1.38	31.03
0.15	1.15	0.46	6.10	0.77	13.19	1.08	21.65	1.39	31.36
0.16	1.27	0.47	6.30	0.78	13.44	1.09	21.94	1.40	31.70
0.17	1.39	0.48	6.50	0.79	13.69	1.10	22.23	1.41	32.04
0.18	1.51	0.49	6.70	0.80	13.94	1.11	22.53	1.42	32.38
0.19	1.63	0.50	6.91	0.81	14.20	1.12	22.83	1.43	32.72
0.20	1.76	0.51	7.12	0.82	14.46	1.13	23.13	1.44	33.06
0.21	1.89	0.52	7.33	0.83	14.72	1.14	23.44	1.45	33.40
0.22	2.02	0.53	7.54	0.84	14.98	1.15	23.75	1.46	33.75
0.23	2.16	0.54	7.75	0.85	15.24	1.16	24.06	1.47	34.10
0.24	2.30	0.55	7.96	0.86	15.50	1.17	24.37	1.48	34.45
0.25	2.44	0.56	8.18	0.87	15.76	1.18	24.68	1.49	34.80
0.26	2.59	0.57	8.40	0.88	16.03	1.19	24.99	1.50	35.15
0.27	2.75	0.58	8.62	0.89	16.30	1.20	25.30		
0.28	2.91	0.59	8.84	0.90	16.57	1.21	25.61		
0.29	3.07	0.60	9.06	0.91	16.84	1.22	25.92		
0.30	3.23	0.61	9.29	0.92	17.11	1.23	26.23		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WEST BR. LITTLE ANTIETAM CREEK AT MONT ALTO, FRANKLIN COUNTY, PA.

1913.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	......	....	0.298	3.20	0.625	9.65	0.795	13.82	0.498	6.87	0.375	4.51	0.218	1.99	0.208	1.86	......	....	0.183	1.61	0.152	1.17	0.130	0.92
2, ...	......	....	0.305	3.31	0.560	8.18	0.845	15.11	0.500	6.91	0.335	3.82	0.215	1.96	0.185	1.57	0.145	1.00	0.175	1.45	0.135	0.98	0.170	1.39
3, ...	0.490	6.70	0.312	3.42	0.518	7.29	0.730	12.19	0.480	6.50	0.328	3.70	0.200	1.76	0.170	1.39	0.160	1.27	0.178	1.49	0.125	0.87	0.185	1.57
4, ...	0.480	6.50	0.315	3.48	0.455	6.00	0.645	10.13	0.450	5.90	0.310	3.39	0.220	2.02	0.160	1.27	0.150	1.15	0.172	1.41	0.140	1.03	0.162	1.29
5, ...	0.470	6.30	0.285	2.99	0.478	6.46	0.610	9.29	0.440	5.71	0.300	3.23	0.255	2.52	0.152	1.17	0.140	1.08	0.172	1.41	0.130	0.92	0.175	1.45
6, ...	0.450	5.90	0.290	3.07	0.460	6.10	0.600	9.06	0.435	5.62	0.335	3.82	0.245	2.37	0.145	1.09	0.125	0.87	0.165	1.33	0.110	0.72	0.175	1.45
7, ...	0.425	5.42	0.290	3.07	0.465	6.20	0.635	9.89	0.468	6.26	0.315	3.48	0.220	2.02	0.145	1.09	0.135	0.98	0.168	1.37	0.445	5.80	0.175	1.45
8, ...	0.420	5.33	0.305	3.31	0.470	6.30	0.545	7.86	0.475	6.40	0.290	3.07	0.200	1.76	0.158	1.25	0.125	0.87	0.160	1.27	0.215	1.96	0.170	1.39
9, ...	0.420	5.33	0.295	3.15	0.470	6.30	0.540	7.75	0.450	5.90	0.270	2.75	0.218	1.99	0.475	6.40	0.135	0.98	0.165	1.33	0.198	1.73	0.175	1.45
10, ...	0.410	5.14	0.280	2.91	0.420	5.33	0.530	7.54	0.420	5.33	0.265	2.67	0.195	1.70	0.250	2.44	0.135	0.98	0.172	1.41	0.188	1.61	0.165	1.33
11, ...	0.390	4.78	0.240	2.30	0.410	5.14	0.490	6.70	0.425	5.42	0.245	2.37	0.180	1.51	0.185	1.57	0.125	0.87	0.162	1.29	0.202	1.79	0.160	1.27
12, ...	0.360	4.24	0.245	2.37	0.450	5.90	0.500	6.91	0.655	10.37	0.245	2.37	0.185	1.57	0.160	1.27	0.095	0.58	0.162	1.29	0.205	1.82	0.158	1.25
13, ...	0.335	3.82	0.230	2.16	0.535	7.64	0.510	7.12	0.545	7.86	0.238	2.27	0.200	1.76	*0.157	1.23	0.095	0.58	0.168	1.37	0.218	1.99	0.165	1.33
14, ...	0.315	3.48	0.235	2.23	0.430	5.52	0.595	8.95	0.550	7.96	0.238	2.27	0.182	1.53	*0.154	1.20	0.105	0.68	0.165	1.33	0.220	2.02	0.175	1.45
15, ...	0.340	3.90	0.220	2.02	†1.840	48.00	0.480	6.50	0.555	8.07	0.270	2.75	0.185	1.57	*0.151	1.16	0.105	0.68	0.158	1.25	0.218	1.99	0.168	1.37
16, ...	0.315	3.48	0.225	2.09	†1.240	26.54	0.470	6.30	0.635	9.89	0.460	6.10	0.180	1.51	*0.148	1.13	0.120	0.82	0.152	1.17	0.160	1.27	0.175	1.45
17, ...	0.320	3.56	0.235	2.23	0.990	19.06	0.500	6.91	0.630	9.77	0.330	3.73	0.185	1.57	0.145	1.09	0.115	0.77	0.162	1.29	0.160	1.27	0.165	1.33
18, ...	0.370	4.42	0.260	2.59	0.865	15.63	0.530	7.54	0.585	8.73	0.245	2.37	0.220	2.02	0.160	1.27	0.115	0.77	0.160	1.27	0.158	1.25	0.188	1.61
19, ...	0.440	5.71	0.270	2.75	0.800	13.94	0.525	7.44	0.540	7.75	0.270	2.75	0.200	1.76	0.160	1.27	0.115	0.77	0.178	1.49	0.158	1.25	0.215	1.96
20, ...	0.400	4.96	0.275	2.83	*0.850	15.24	0.510	7.12	0.555	8.07	0.240	2.30	0.185	1.57	......	....	0.105	0.68	0.152	1.17	0.150	1.15	0.210	1.89
21, ...	0.335	3.82	0.330	3.73	*1.100	22.23	0.515	7.22	0.532	7.58	0.275	2.83	0.405	5.05	......	....	0.115	0.77	0.155	1.21	0.150	1.15	......	....
22, ...	0.330	3.73	......	*3.73	*0.950	17.93	0.515	7.22	0.515	7.22	0.225	2.09	0.265	2.67	......	....	0.115	0.77	0.168	1.37	0.135	0.98	......	....
23, ...	0.350	4.07	0.335	3.82	*0.900	16.57	0.500	6.91	0.502	6.95	0.305	3.31	0.200	1.76	......	....	0.215	1.96	0.190	1.63	0.132	0.94	......	....
24, ...	0.350	4.07	*0.318	3.53	*0.850	15.24	0.515	7.22	0.480	6.50	0.330	3.73	0.255	2.52	......	....	0.735	2.32	0.170	1.39	0.145	1.09	......	....
25, ...	0.325	3.64	0.300	3.23	0.830	14.72	0.470	6.30	0.465	6.20	0.260	2.59	0.212	1.92	......	....	0.425	5.42	0.170	1.39	0.152	1.17	......	....
26, ...	0.300	3.23	0.730	12.19	0.800	13.94	0.435	5.62	0.440	5.71	0.250	2.44	0.185	1.57	......	....	0.280	2.91	0.160	1.27	0.150	1.15	......	....
27, ...	0.270	2.75	0.885	16.16	0.765	13.06	0.585	8.73	0.415	5.24	0.265	2.67	0.198	1.73	......	....	0.225	2.09	0.152	1.17	0.145	1.09	......	....
28, ...	0.290	3.07	0.790	13.69	0.800	13.94	0.470	6.30	0.415	5.24	0.250	2.44	0.180	1.51	......	....	0.225	2.09	0.152	1.17	0.150	1.15	......	....
29, ...	0.295	3.15	0.715	11.82	1.190	24.99	0.490	6.70	0.405	5.06	0.245	2.37	0.210	1.89	......	....	0.215	1.96	0.152	1.17	0.145	1.09	......	....
30, ...	0.285	2.99	......	......	0.910	16.84	0.540	7.75	0.416	5.25	0.225	2.09	0.210	1.89	......	....	0.195	1.70	0.148	1.18	0.145	1.09	......	....
31, ...	0.300	3.23	......	......	0.855	15.37	......	......	0.390	4.78	......	....	0.215	1.96	......	....	......	....	0.145	1.09	......	....	......	....

*Estimated. †Water flowing over top of dam; discharge estimated. Vacation periods; no readings taken on Jan. 1 and 2, Aug. 20-Sept. 1, incl., and Dec. 21-31, incl.

ESTIMATED MONTHLY DISCHARGE OF WEST BRANCH LITTLE ANTIETAM CREEK, AT MONT ALTO, FRANKLIN COUNTY, PA.

(Drainage area 3.5 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	6.70	2.75	4.37	1.249	1.348
February,	16.16	2.02	4.39	1.254	1.352
March,	†48.00	5.14	13.39	3.826	4.411
April,	15.11	5.62	8.14	2.326	2.595
May,	10.37	4.78	6.81	1.946	2.244
June,	6.10	2.09	3.01	.860	.960
July,	5.06	1.51	1.97	.563	.649
September,	12.32	.58	1.67	.477	.515
October,	1.63	1.09	1.32	.377	.435
November,	5.80	.72	1.45	.414	.462

†Water flowing over top of dam, discharge estimated.
Note.—The mean for January and September is for 29 days.

MONOCACY RIVER.

DESCRIPTION OF BASIN.

The Monocacy river, one of the largest tributaries of the Potomac river, rises in Adams county, Pennsylvania, in two branches; namely, Rock and Marsh creeks. Rock creek rises in the central part of Adams county, in Strabane Township, and flows in a southerly direction into Maryland. Marsh creek rises in the western part of Adams county, in Franklin township, and flows southeasterly to its confluence with Rock creek, about one-quarter mile below the state line, thus forming the Monocacy river. Several tributaries joining the Monocacy river, in Maryland, drain portions of southwestern and southeastern Adams county, Pennsylvania; namely, Alleway, Piney and Middle creeks. The total drainage area of the Monocacy river is approximately 940 square miles, of which 231 lie in Pennsylvania. Its length, below the confluence of Rock and Marsh creeks, is about 55 miles. The river throughout the greater portion of its course flows through a rolling, limestone country of highly cultivated farms and is polluted by washings from tanneries and mills along its banks and its tributaries. The largest towns in its watershed are Gettysburg, Pennsylvania, and Frederick, Md., the former of which obtains part of its domestic water supply from Marsh creek, while the latter receives its domestic water supply from the parent stream. There are numerous small mills on its tributaries which are operated by water power.

The mean annual precipitation over this watershed, in Pennsylvania, is from 40 to 45 inches.

The discharge of this stream has been measured at Frederick, Md., since August 4th, 1896.

POTOMAC BASIN—STATION NO. 2.

MONOCACY RIVER AT FREDERICK, MARYLAND.

DESCRIPTION OF STATION.

This station was established on August 4th, 1896, by the United States Geological Survey and is being maintained through co-operation with the Maryland State Weather Bureau. It is located at the county iron bridge on the turnpike four miles northeast of Frederick, on the road leading from Frederick to Mt. Pleasant, Md.

The channel is straight for 300 feet above and 100 feet below the bridge. Both banks are low and liable to overflow, but all water passes beneath the bridge. The bed is composed of gravel and cobble stones, except near the bank, where it is composed of silt and is subject to change.

Discharge measurements are made from the two span highway bridge. The channel at this point is divided by a small, low island, which serves as a foundation for the pier of the bridge. The right channel is measured from the lower and the left channel from the upper side of the bridge. The pier and island obstruct the flow to some extent, causing dead water for 20 feet to the right of the pier at low water and eddies at high water. The initial point for soundings is a cross cut in the face of the parapet wall on the lower wing of the right abutment.

From August 4th, 1896 to September 3rd, 1902, readings were taken on a wire gage which was attached to the floor timbers on the lower side of the bridge, the pulley being 115 feet from an initial point established for making soundings, and the length of wire given to be 35.20 feet. On September 3rd, 1902, the wire gage was replaced by a standard chain gage, which is located in the middle of the first span from the right bank and is attached to the bridge floor on the lower side of the bridge. The length of chain from the bottom of the weight to the marker was 35.20 feet but was subsequently changed to 35.04 feet. The bench mark is a hole drilled in the top of a coping stone on the lower wing of the right abutment, about 100 feet back from the initial point for soundings. Its elevation is 29.17 feet above gage datum. The gage is read twice daily by E. L. Derr.

The discharge is liable to be affected by ice conditions, more or less, during the winter months. Israel creek enters the river about 2,000 feet below the station and Tuscarora creek about 3,000 feet above. All data prior to January 1st, 1903, when the wire gage was in operation, have been revised.

Owing to the change in channel conditions at this station, it has been necessary to use several rating tables.

Since the establishment of this station, 39 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF MONOCACY RIVER, AT FREDERICK MARYLAND.

(Drainage area 660 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913.							
37	Aug. 14,	Padgett & Batchelder.	132	175	0.96	3.99	166	0.6 method.
38	Aug. 28,	Stevens, ...	76	63	1.20	3.67	76	Wading msmt. above bridge.
39	Aug. 28,	Stevens, ...	84	59	1.29	3.67	76	Wading msmt. below bridge.

DISCHARGE TABLE FOR MONOCACY RIVER, AT FREDERICK, MD., FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
3.40	32	.40	784	.40	2190	.40	4060	.40	6010
.50	45	.50	790	.50	2280	.50	4155	.50	6110
.60	62	.60	846	.60	2370	.60	4250	.60	6210
.70	82	.70	904	.70	2460	.70	4345	.70	6310
.80	104	.80	964	.80	2550	.80	4440	.80	6410
.90	130	.90	1026	.90	2640	.90	4535	.90	6510
4.00	158	6.00	1090	8.00	2730	10.00	4630	12.00	6610
.10	188	.10	1155	.10	2825	.10	4725	.10	6710
.20	218	.20	1225	.20	2920	.20	4820	.20	6810
.30	250	.30	1295	.30	3015	.30	4915	.30	6915
.40	284	.40	1365	.40	3110	.40	5010	.40	7020
.50	320	.50	1440	.50	3205	.50	5110	.50	7125
.60	358	.60	1520	.60	3300	.60	5210	.60	7230
.70	398	.70	1600	.70	3395	.70	5310	.70	7335
.80	440	.80	1680	.80	3490	.80	5410	.80	7440
.90	484	.90	1765	.90	3585	.90	5510	.90	7545
5.00	530	7.00	1850	9.00	3680	11.00	5610	13.00	7650
.10	578	.10	1935	.10	3775	.10	5710		
.20	628	.20	2020	.20	3870	.20	5810		
.30	680	.30	2105	.30	3965	.30	5910		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 3 low water discharge measurements made during 1913, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF MONOCACY RIVER AT FREDERICK, MD.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	9.5	4160	5.6	846	7.5	2280	7.6	2370	6.5	1440	4.9	484	4.9	484	4.7	398	4.3	250	6.3	1300	4.4	284	4.4	284
2,	7.5	2280	5.6	846	6.9	1760	7.4	2190	5.7	904	4.8	440	4.7	398	4.9	484	4.3	250	5.8	964	4.4	284	4.4	284
3,	6.5	1440	5.6	846	6.2	1220	8.5	3200	5.5	790	4.7	398	4.6	358	4.6	358	4.3	250	5.3	680	4.5	320	4.5	320
4,	6.3	1300	5.5	790	5.9	1030	6.7	1600	5.4	734	4.7	398	4.6	358	4.5	320	4.6	358	5.2	628	4.5	320	4.7	398
5,	6.1	1160	5.6	846	5.5	790	6.5	1440	5.3	680	4.7	398	4.7	398	4.3	250	4.5	320	5.1	578	4.5	320	4.7	398
6,	5.9	1030	....	650	5.7	904	6.4	1360	5.3	680	4.7	398	4.6	358	4.4	284	4.4	284	5.0	530	4.5	320	5.3	680
7,	....	800	....	650	5.9	1030	6.2	1220	6.4	1360	4.7	398	4.6	358	4.3	250	4.4	284	4.9	484	4.5	320	6.8	1680
8,	....	800	....	650	6.4	1360	8.2	2920	6.2	1220	4.7	398	4.5	320	4.3	250	4.5	320	4.8	440	7.5	2280	5.1	578
9,	....	800	....	650	6.6	1520	6.9	1760	6.7	1600	4.7	398	4.4	284	4.7	398	4.4	284	4.8	440	6.3	1300	5.0	530
10,	....	800	....	650	6.5	1440	6.5	1440	6.4	1360	4.6	358	4.3	250	4.7	398	4.3	250	4.7	398	5.2	628	4.9	484
11,	....	800	....	650	6.3	1300	6.3	1300	5.7	904	4.5	320	4.4	284	9.1	3780	4.3	250	4.7	398	5.2	628	4.7	398
12,	....	800	....	650	6.0	1090	5.8	964	6.0	1090	4.5	320	4.7	398	8.5	3200	4.2	218	4.7	398	5.0	530	4.5	320
13,	....	800	....	650	13.5	8180	5.8	964	6.5	1440	4.5	320	5.3	680	6.9	1760	4.0	158	4.7	398	4.8	440	4.3	250
14,	....	800	....	650	13.8	8490	6.9	1760	5.7	904	4.5	320	5.0	530	4.9	484	4.0	158	4.6	358	4.7	398	4.3	250
15,	....	800	....	650	17.4	12300	6.1	1160	5.7	904	4.5	320	4.7	398	4.6	358	4.0	158	4.6	358	4.6	358	4.5	320
16,	....	800	....	650	19.4	14400	7.1	1940	5.7	904	5.0	530	4.6	358	4.6	358	4.0	158	4.5	320	4.6	358	4.5	320
17,	....	800	....	650	9.7	4340	7.0	1850	7.5	2280	4.9	484	4.6	358	4.5	320	4.0	158	4.5	320	4.6	358	4.5	320
18,	....	800	5.3	680	8.5	3200	7.4	2190	6.9	1760	4.8	440	8.6	3300	4.5	320	4.0	158	4.5	320	4.5	320	4.6	358
19,	....	800	5.2	628	8.2	2920	7.1	1940	5.7	904	4.8	440	7.6	2370	4.5	320	4.2	218	4.5	320	4.5	320	5.4	734
20,	....	800	7.1	1940	8.0	2780	6.4	1360	5.3	680	4.8	440	5.0	530	4.5	320	4.1	188	4.5	320	4.5	320	5.3	680
21,	....	800	7.5	2280	8.7	3400	6.2	1220	5.4	734	4.7	398	5.0	530	4.8	440	4.1	188	4.5	320	4.5	320	5.2	628
22,	....	800	18.5	13400	8.3	3020	5.9	1030	5.3	680	4.6	358	6.3	1300	4.6	358	4.1	188	4.6	358	4.5	320	5.2	628
23,	....	800	9.0	3680	7.5	2280	5.8	964	5.2	628	4.6	358	5.6	846	4.5	320	4.25	234	4.7	398	4.5	320	5.2	628
24,	....	800	7.1	1940	12.9	7540	5.6	846	5.1	578	4.6	3.58	5.5	790	4.5	320	7.0	1850	4.9	484	4.5	320	5.3	680
25,	....	800	6.5	1440	12.0	6610	5.5	790	5.1	578	5.2	628	6.0	1090	4.5	320	22.7	17800	4.9	484	4.5	320	5.5	790
26,	....	800	14.1	8800	9.5	4160	5.5	790	5.0	530	5.2	628	5.5	790	4.4	284	18.5	13400	4.7	398	4.5	320	5.6	846
27,	....	800	15.4	10200	8.4	3110	6.0	1090	4.8	440	7.7	2460	5.1	578	4.3	250	7.9	2640	4.6	358	4.5	320	6.3	1300
28,	5.5	790	9.5	4160	7.4	2190	5.9	1030	4.8	440	5.7	904	4.9	484	4.3	250	7.5	2280	4.6	358	4.5	320	6.7	1600
29,	5.5	790	8.9	3580	18.0	12900	5.8	964	4.8	440	5.2	628	4.7	398	4.3	250	6.9	1760	4.6	358	4.4	284	6.0	1090
30,	5.5	790	....	......	10.9	5510	6.9	1760	5.0	530	5.0	530	4.9	484	4.3	250	6.5	1440	4.5	320	4.4	284	10.6	5210
31,	5.5	790	....	......	8.5	3200	....	......	5.0	530	....	......	4.8	440	4.3	250	....	......	4.4	284	....	......	15.0	9750

Note.—Jan. 7 to 27, and Feb. 6 to 17, incl., river frozen. Discharge estimated.

ESTIMATED MONTHLY DISCHARGE OF MONOCACY RIVER, AT FREDERICK, MD.

(Drainage area 660 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	4160	790	1010	1.53	1.76
February,	13400	628	2230	3.38	3.64
March,	14400	790	4070	6.17	7.11
April,	3200	790	1510	2.29	2.56
May,	2230	440	924	1.40	1.61
June,	2460	320	508	.770	.86
July,	3300	250	661	1.00	1.15
August,	8780	250	577	.874	1.01
September,	17800	158	1550	2.35	2.62
October,	1360	284	454	.688	.79
November,	2280	284	451	.683	.76
December,	9750	250	1060	1.61	1.86
The year,	17800	158	1250	1.89	25.73

Note.—Jan. 7 to 27, and Feb. 6 to 17, incl., river frozen. Discharge estimated.

OHIO BASIN

GAGING STATIONS IN OHIO BASIN.

No.	Stream.	Location.	Established.	Discontinued.	Re-established.	1912 Information Available.
1.	Allegheny river,	Redhouse, N. Y.,	Sept. 4, 1908,			Discharge complete.
2.	Conewango creek,	Frewsburg, N. Y.,	Oct. 25, 1909,			Discharge msmts. and gage heights.
3.	Kinzua creek,	Dewdrop, Pa.,	Oct. 23, 1909,	Nov. 20, 1911,	July 22, 1912,	Discharge complete.
4.	Brokenstraw creek,	Youngsville, Pa.,	Oct. 22, 1909,			Discharge complete.
5.	Tionesta creek,	Nebraska, Pa.,	July 26, 1912,			Discharge msmts. and gage heights.
6.	Oil creek,	Rouseville, Pa.,	Oct. 20, 1909,			Discharge complete.
7.	North Branch French creek,	Kimmeytown, Pa.,	May 4, 1910,			Discharge complete.
8.	Cussewago creek,	Meadville, Pa.,	May 2. 1910,			Discharge complete.
9.	French creek,	Carlton, Pa.,	April 29, 1908,			Discharge complete.
10.	Sugar creek,	Wyattville, Pa.,	May 6, 1910,			Discharge complete.
11.	Clarion river,	Clarion, Pa.,	Nov. 17, 1884,			Discharge complete.
12.	Red Bank creek,	St. Charles, Pa.,	Oct. 19, 1909,			Discharge complete.
13.	Mahoning creek,	Dee, Pa.,	Oct. 18, 1909,			Discharge msmts. and discharge table.
14.	Allegheny river,	Kittanning, Pa.,	Aug. 18, 1904,			Discharge complete.
15.	Crooked creek,	Rosston, Pa.,	Oct. 16, 1909,			Discharge complete.
16.	Black Lick creek,	Black Lick, Pa.,	Aug. 16, 1904,	July 15, 1906,	Jan. 8, 1907,	Discharge complete.
17.	Loyalhanna creek,	New Alexandria, Pa.,	Oct. 7, 1910,			Discharge complete.
18.	Kiskiminetas river,	Avonmore, Pa.,	May 29, 1907,			Discharge complete.
19.	Shenango river,	Turnerville, Pa.,	Feb. 1, 1912,			Discharge complete.
20.	Shenango river,	Sharon, Pa.,	Aug. 1, 1909,			Discharge complete.
21.	Neshannock creek,	New Castle, Pa.,	Aug. 9, 1909,			Discharge msmts. and gage heights.
22.	Slippery Rock creek,	Wurtemberg, Pa.,	Dec. 28, 1911,			Discharge complete.
23.	Cheat river,	Morgantown, W. Va.,	July 8, 1899,	Dec. 30, 1899, Dec. 29, 1900, Dec. 31, 1905,	July 1, 1900, Aug. 21, 1902, Nov. 18, 1908,	Discharge complete.
24.	Tygart river,	Fetterman, W. Va.,	June 8, 1907,			Discharge complete.
25.	West Fork river,	Enterprise, W. Va.,	June 2, 1907,			Discharge complete.
26.	Dunkard creek,	"Bobtown," Pa.,	Oct. 14, 1909,			Discharge msmts. and gage heights.
27.	Turtle creek,	East Pittsburgh, Pa.,	Dec. 1, 1907,			Discharge complete.
28.	Youghiogheny river,	Confluence, Pa.,	Sept. 15, 1904,			Discharge complete.
29.	Casselman river,	Confluence, Pa.,	Sept. 15, 1904,			Discharge complete.
30.	Laurel Hill creek,	Confluence, Pa.,	Sept. 15 1904,			Discharge complete.
31.	Youghiogheny river,	Connellsville, Pa.,	July 22, 1908,			Discharge complete.

ALLEGHENY RIVER.

DESCRIPTION OF BASIN.

The Allegheny river, the largest tributary of the Ohio river in Pennsylvania, draining 11,160 square miles in Pennsylvania and New York, rises in the hilly plateau on the west slope of the Allegheny mountains in northwestern Pennsylvania, at an elevation of about 2,250 feet above sea level. Its tributaries drain the west slope of these mountains from Somerset county, near the southern boundary, through the Conemaugh river, to the extreme northern boundary, and westward nearly to the Ohio line through Oil and French creeks.

Its actual source is in Potter county, in about the center of the northern border of the State, whence it flows northwesterly for about 80 miles into New York, thence about 120 miles southwesterly into Pennsylvania again, 47 miles being in New York. From this point it is 110 miles to the mouth, its junction with the Monongahela river at Pittsburgh, where the Ohio river is formed; the total length of the river being 310 miles.

In Potter and McKean counties the river and its tributaries are small mountain streams, in well wooded, steep valleys, and a sparsely inhabited region. In New York the main valley is wide and flat, the slope slight and the land under a high state of cultivation, and thickly populated. Coming back into Pennsylvania the hills converge, the valley narrowing and the slope is steeper. The population again becomes scattered, the tributary valleys well wooded, and the bordering hills are high and timbered. The larger tributaries, however, contain large areas of cleared, cultivated land, notably those from the west.

The lower 150 miles is more densely populated, many railroads and large towns and thriving industries bordering its banks, and using its waters. For 25 miles above Pittsburgh the river has been slackwatered by three dams and the banks are almost continuously populated.

For the upper 30 miles, the slope is 27 feet per mile, the next 65 miles, 2.4 feet per mile, the next 87 miles, 3.7 feet per mile, and the lower 126 miles, 2.1 feet per mile.

In the first 115 miles of its length the river bed consists mostly of fine sand and gravel, much of it lying above the terminal morain; from this point, however, the bottom changes to loose stones and boulders, riffles occur frequently, but seldom is solid rock in evidence.

The largest tributary, the Kiskiminetas river, draining 1,892 square miles, comes in 25 miles above the junction of the Monongahela and Allegheny rivers, no streams of importance joining it between. From that point up many large tributaries come in, mostly from the east, as follows: Crooked, Mahoning and Red Bank creeks, Clarion river, French, Oil, Tionesta, Brokenstraw, Conewango and Kinzua creeks, several of which drain over 1,000 square miles. Those from the west, French, Oil, Brokenstraw and Conewango drain the glaciated area, containing rounded gravel hills and numerous lakes and swamps, little timber and their watersheds are quite generally cultivated. Those from the east drain a mountainous, timbered and less inhabited and cultivated country.

The drainage basin is about 124 miles in extreme width and 175 miles in length, much narrower at its southern point, and its greatest width is at the Pennsylvania-New York State line.

The basin embraces widely varying topographic conditions, ranging from high, rough mountainous country along the east boundary, to broad, terraced valleys with wide bottom lands in New York State. In it are included the oil and gas producing regions, vast bituminous coal fields, much of the remaining merchantable timber and many other valuable natural resources.

Most of this basin lies in the zone of 40 to 45 inch rainfall, while a small portion along the southwestern part is subject to 45 to 50 inch rainfall, and another small section near the mouth to from 35 to 40 inches.

The flow is measured at Kittanning, 48 miles above Pittsburgh, and at Red House, New York, since August 18, 1904, and September 4, 1903, respectively.

OHIO BASIN—STATION NO. 1.

ALLEGHENY RIVER AT RED HOUSE, NEW YORK.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on September 4th, 1903, on the Red House bridge, near the station of the Erie and Pennsylvania railroads and about five miles below Salamanca, N. Y., about 13 miles above the point where the river leaves New York State. It is maintained by the United States Geological Survey in co-operation with the New York State Engineer.

The channel is straight for 800 feet above and below the station, it being 494 feet wide between abutments, broken by two piers. The right bank is high and does not overflow, while the left bank overflows only at flood stages. At extreme high water there is an additional flood channel on the left bank. The bed is of gravel and is regular, and the current velocity is well distributed.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being the left end of the downstream side of the bridge.

A standard chain gage is fastened to the upstream side of the bridge in the middle of the left span. The length of chain from the bottom of the weight to the marker is 24.16 feet. The bench mark is a circle cut on the downstream side of the left abutment; elevation 21.09 feet above the datum of the gage. The gage is read twice each day by O. A. Gates.

At Olean, N. Y., the wasteway from the Cuba reservoir enters the stream through Olean creek. This reservoir is located on the divide between Oil creek, tributary to Allegheny river, and Genessee river. The storage is commonly turned into Genessee river through the abandoned summit level of Genessee Valley Canal, but may be diverted into Oil creek through the guard locks at the head of the canal. Moderate ice conditions usually prevail during the winter months.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF ALLEGHENY RIVER, AT RED HOUSE, NEW YORK.

(Drainage area 1,640 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage heights.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912.							
28	Feb. 15,	DeGolyer, ...	375	808	0.63	4.87	509	Msmt. under complete ice cover 0.2 and 0.8 method.
29	July 15,	Weber, ...	327	1040	0.52	3.30	542	0.2 and 0.8 method.
30	Dec. 6,	DeGolyer, ...	351	1970	3.38	6.67	6670	0.2 and 0.8 method.
31	Dec. 6,	DeGolyer, ...	351	1990	3.61	6.72	7190	0.2 and 0.8 method.

DISCHARGE TABLE FOR ALLEGHENY RIVER, AT RED HOUSE, NEW YORK, FOR 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
2.40	41	.50	2000	.60	6780	.70	14550	.80	25100
.50	70	.60	2160	.70	7080	.80	15000	.90	25650
.60	106	.70	2320	.80	7390	.90	15450	11.00	26200
.70	150	.80	2490	.90	7720	9.00	15900	.10	26750
.80	200	.90	2670	7.00	8050	.10	16350	.20	27300
.90	256	5.00	2860	.10	8400	.20	16800	.30	27850
3.00	318	.10	3060	.20	8750	.30	17300	.40	28400
.10	386	.20	3260	.30	9100	.40	17800	.50	28950
.20	460	.30	3470	.40	9450	.50	18300	.60	29500
.30	540	.40	3690	.50	9800	.60	18800	.70	30050
.40	626	.50	3910	.60	10150	.70	19300	.80	30600
.50	722	.60	4140	.70	10500	.80	19800	.90	31200
.60	828	.70	4370	.80	10850	.90	20300	12.00	31800
.70	940	.80	4610	.90	11250	10.00	20800	.10	32400
.80	1060	.90	4850	8.00	11650	.10	21300	.20	33000
.90	1180	6.00	5100	.10	12050	.20	21800	.30	33600
4.00	1305	.10	5360	.20	12450	.30	22350	.40	34200
.10	1435	.20	5630	.30	12850	.40	22900	.50	34800
.20	1570	.30	5910	.40	13250	.50	23450		
.30	1710	.40	6190	.50	13650	.60	24000		
.40	1850	.50	6480	.60	14100	.70	24550		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on seven discharge measurements made during 1912-13, and somewhat on three measurements made during 1908-09-10.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF ALLEGHENY RIVER AT RED HOUSE, N. Y.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	5.4	4060	....	800	....	470	10.4	22900	7.2	8750	3.7	940	2.90	256	3.15	423	4.60	2160	4.70	2320	4.40	1850	4.45	1920
2, ...	5.5	4310	....	700	....	530	11.0	26200	6.7	7080	3.65	884	2.90	256	3.25	500	5.00	2860	5.00	2860	4.50	2000	4.80	2490
3, ...	5.4	4060	....	700	....	700	10.6	24000	6.2	5630	3.85	1120	2.95	287	3.50	772	6.60	6780	5.80	4610	4.40	1850	6.90	7720
4, ...	....	3800	....	700	....	700	9.9	20800	5.4	3690	3.55	775	2.90	256	3.30	540	6.20	5630	5.40	3690	4.40	1850	6.85	7560
5, ...	....	3500	....	700	....	800	9.3	17800	5.0	2860	3.55	775	2.90	256	3.20	460	5.80	4610	5.00	2860	4.35	1780	5.80	4610
6, ...	....	2920	....	600	....	800	9.5	18300	4.9	2670	3.55	775	2.95	287	3.20	460	5.60	4140	4.00	1300	4.45	1920	6.70	7060
7, ...	....	2500	....	600	....	1000	9.0	15900	4.8	2490	3.40	626	3.00	318	3.10	386	5.00	2860	3.90	1180	5.20	3260	6.20	5630
8, ...	....	2000	....	600	....	1000	8.6	14100	4.7	2320	3.35	583	3.00	318	3.30	540	4.80	2490	3.95	1240	5.80	4610	6.20	5630
9, ...	....	1700	....	600	....	1000	8.7	14550	4.6	2160	3.30	540	3.15	423	3.10	386	4.50	2000	3.90	1180	5.80	4610	5.60	4140
10, ...	....	1500	....	500	....	900	8.1	12050	4.5	2000	3.25	500	3.10	386	3.05	352	4.10	1440	3.80	1060	5.50	3910	5.10	3060
11, ...	....	1200	....	500	....	1000	7.9	11250	4.5	2000	3.20	460	3.25	500	3.05	352	4.60	2160	4.10	1440	5.50	3910	5.20	3260
12, ...	....	1100	....	500	....	1000	7.5	9800	4.6	2160	3.20	460	3.30	540	3.05	352	5.00	2860	4.20	1570	5.50	3910	5.40	3690
13, ...	....	1100	....	500	....	1400	6.6	6780	4.8	2490	3.20	460	3.30	540	3.10	386	5.00	2860	3.80	1060	5.60	4140	5.50	3910
14, ...	....	1100	....	500	....	1500	6.5	6480	5.0	2860	3.20	460	3.35	583	3.40	626	5.40	3690	3.90	1180	5.90	4850	5.40	3690
15, ...	....	1000	....	509	....	2000	6.4	6190	5.0	2860	3.20	460	3.30	540	3.30	540	5.40	3690	3.80	1060	5.80	4610	4.80	2490
16, ...	....	1000	....	510	....	3000	6.0	5100	5.4	3690	3.25	500	3.35	583	3.25	500	4.85	1780	3.80	1060	5.50	3910	4.40	1850
17, ...	....	1000	....	510	7.0	8050	6.0	5100	6.3	5910	3.20	460	3.45	674	3.15	423	4.10	1440	3.65	884	5.20	3260	4.40	1850
18, ...	....	1000	....	510	7.8	10850	5.8	4610	6.8	7390	3.10	386	3.40	626	3.55	775	4.10	1440	3.60	828	5.20	3260	4.25	1640
19, ...	....	900	....	500	8.3	12850	5.5	3910	6.6	6780	3.15	423	3.50	722	3.45	674	4.00	1300	3.60	828	4.80	2490	4.20	1570
20, ...	....	900	....	500	9.5	18300	5.4	3690	5.4	3690	3.10	386	3.75	1000	3.55	775	4.00	1300	3.60	828	4.20	1570	4.10	1440
21, ...	....	900	....	500	8.7	14550	5.3	3470	5.0	2860	3.10	386	3.60	828	3.55	775	3.90	1180	3.65	884	4.20	1570	4.00	1300
22, ...	....	900	....	500	7.3	9100	5.2	3260	5.2	3260	3.05	352	3.35	583	3.60	828	3.95	1240	3.60	828	4.00	1300	4.10	1440
23, ...	....	900	....	500	6.4	6190	5.1	3060	4.8	2490	3.00	318	3.30	540	3.65	884	4.00	1300	4.30	1710	4.00	1300	4.00	1300
24, ...	....	900	....	500	6.1	5360	5.0	2860	4.5	2000	3.00	318	3.25	500	3.70	940	4.00	1300	6.20	5630	4.20	1570	4.20	1570
25, ...	....	800	....	510	5.5	3910	5.1	3060	4.6	2160	2.90	256	3.20	460	3.65	884	4.40	1850	5.80	4610	4.00	1300	4.10	1440
26, ...	....	800	....	510	5.0	2860	5.2	3260	4.4	1850	2.95	287	3.20	460	4.10	1440	4.45	1920	5.70	4370	3.95	1240	4.00	1300
27, ...	....	800	....	500	5.0	2860	5.2	3260	4.25	1640	2.90	256	3.20	460	4.00	1300	4.70	2320	5.40	3690	3.90	1180	4.20	1570
28, ...	....	800	....	500	5.4	3690	5.4	3690	3.95	1240	2.90	256	3.20	460	4.20	1570	4.60	2160	5.00	2860	3.95	1240	4.60	2160
29, ...	....	800	....	500	7.9	11250	5.8	4610	3.9	1180	2.90	256	3.20	460	4.20	1570	4.80	2490	4.80	2490	3.90	1180	4.60	2160
30, ...	....	800	....	......	9.6	18800	7.4	9450	3.95	1240	2.90	256	3.10	386	4.40	1850	4.70	2320	4.60	2160	3.90	1180	4.55	2080
31, ...	....	800	....	......	9.8	19800	....	......	3.9	1180	....	......	3.10	386	4.15	1500	....	......	4.50	2000	....	......	4.55	2080

Note.—Jan. 4 to Mar. 16, incl., frozen and discharge estimated.

ESTIMATED MONTHLY DISCHARGE OF ALLEGHENY RIVER, AT RED HOUSE, NEW YORK.

(Drainage area 1,640 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	4310	800	1610	0.982	1.130
February,	800	500	554	0.338	0.360
March,	19800	470	5520	3.370	3.880
April,	26200	2860	9480	5.780	6.450
May,	8750	1180	3240	1.980	2.280
June,	1120	256	497	0.303	0.340
July,	1000	256	480	0.293	0.340
August,	1850	352	765	0.466	0.540
September,	6780	1180	2520	1.540	1.720
October,	5630	828	2070	1.260	1.450
November,	4850	1180	2550	1.550	1.730
December,	7720	1300	3020	1.840	2.120
The year,	26200	256	2690	1.642	22.340

Note.—Jan. 4 to March 16, incl., frozen and discharge estimated.

CONEWANGO CREEK.

DESCRIPTION OF BASIN.

Conewango creek is one of the largest tributaries of the Allegheny river, draining a total area of approximately 825 square miles, 688 of which lie in New York State. Rising in the western part of Callaiagus county, N. Y., it flows southwardly across the New York-Pennsylvania State line, in Warren county, about 10 miles west of where the Allegheny river crosses. Its source and all of its basin lie in the once glaciated region, abounding in lakes, ponds and marshes, the country being rolling and largely deforested, under cultivation and well inhabited. The valleys are broad and flat. The Chautauqua Lake in New York, lies on a tributary of Cassadoga creek, and below its junction the valley is particularly flat, and the stream very sluggish.

The mean annual precipitation over this water shed is from 40 to 45 inches.

The discharge has been measured since October, 1909, at Frewsburg, New York.

CONEWANGO CREEK AT FREWSBURG, NEW YORK.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, on October 25th, 1909, at Whitman's bridge, one mile above Frewsburg and 18 miles above the mouth.

The channel is straight for 75 feet above the station, when it makes a bend to the left, while the channel below the station is straight for 600 feet. The right bank is wide, low meadow land and overflows at high stages. The left bank is a railroad embankment and does not overflow. The bed is of clay and gravel and is somewhat shifting. On the right bank a one hundred foot trestle approach to the railroad bridge passes water around that end during floods, while other flood waters get through a culvert, on the right bank some distance from the bridge, where it is measured.

Discharge measurements are made from the downstream side of the highway bridge and from the railroad bridge 75 feet below during extreme floods. The initial point for soundings on the highway bridge is center of hand-rail post, left end of bridge, looking downstream.

A chain gage is attached on the railroad bridge near the left bank. The length of chain from the bottom of the weight to the center of the marker is 22.70 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is the outer downstream corner of coping stone of left abutment, downstream wing wall; elevation 19.87 feet above gage datum. The gage is read twice daily by Lester Hobart.

On account of slack water from numerous mill dams there is no point on the stream nearer the mouth where a gaging station is available.

Since the establishment of this station, twelve discharge measurements have been made. Owing to an insufficient number of discharge measurements, no rating curve has been computed, and only the discharge measurements and gage heights have been published. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CONEWANGO CREEK, AT FREWSBURG, CHAUTAUQUA COUNTY, N. Y.

(Drainage area 690 square miles.)

No.	Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
13	1913. Mar. 30,	Boehringer & Knight.	170	2581	3.28	13.83	8462	Surface measurement.

DAILY MEAN GAGE HEIGHTS OF CONEWANGO CREEK AT FREWSBURG, CHAUTAUQUA COUNTY, N. Y.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1, ...	6.59	3.39	5.23	14.15	8.61	2.10	0.94	0.77	2.84	1.88	4.39	3.01
2, ...	6.91	3.39	4.83	14.55	9.38	2.25	1.09	0.75	3.21	1.84	4.09	5.45
3, ...	*6.39	3.29	4.28	14.39	8.56	2.10	1.19	1.07	3.04	1.98	4.94	8.41
4, ...	....	3.24	3.88	13.72	5.64	2.15	1.11	....	2.49	2.01	4.64	8.91
5, ...	†	3.11	3.78	13.27	4.54	1.85	1.13	0.85	2.64	1.91	4.34	8.81
6, ...	....	3.09	3.68	13.22	4.61	1.67	1.24	0.77	2.79	1.81	3.92	8.91
7, ...	4.79	3.19	3.58	13.47	5.06	1.60	1.29	0.62	2.89	1.64	3.86	8.51
8, ...	....	3.29	3.61	13.62	4.91	1.57	1.39	0.65	2.64	1.61	6.19	7.56
9, ...	....	3.09	3.88	13.17	4.51	1.55	1.44	0.72	2.49	2.11	7.22	6.51
10, ...	‡3.79	2.49	3.83	12.87	4.11	1.50	3.34	0.82	2.24	2.46	7.89	5.81
11, ...	3.87	2.44	3.58	11.71	3.88	1.35	2.70	0.87	2.09	2.48	7.76	5.21
12, ...	3.49	2.44	3.38	10.25	3.74	1.40	1.89	0.87	1.79	2.56	7.66	4.41
13, ...	3.79	2.49	a3.23	9.47	4.16	1.57	1.64	0.87	1.59	2.56	6.74	4.21
14, ...	3.47	2.59	3.08	8.92	4.24	1.63	1.36	0.87	1.61	2.48	5.24	3.81
15, ...	3.19	2.69	3.68	8.99	4.26	1.65	1.12	0.82	1.54	2.36	4.19	3.81
16, ...	3.29	2.69	7.88	9.59	4.06	1.80	1.06	0.77	2.11	2.31	3.94	3.71
17, ...	3.12	2.64	9.83	9.39	4.76	1.57	0.94	0.57	1.84	2.31	3.78	3.76
18, ...	3.12	2.59	11.12	8.97	4.74	1.65	1.12	0.67	1.81	2.21	3.62	4.26
19, ...	4.44	2.49	11.86	6.97	4.38	1.57	1.29	0.67	1.74	2.14	3.52	5.91
20, ...	5.09	2.69	13.08	6.52	3.86	1.51	1.32	0.79	1.64	2.06	3.44	5.41
21, ...	5.09	2.79	13.20	6.17	3.24	1.73	1.16	0.85	1.74	2.01	3.24	5.21
22, ...	5.19	....	12.78	5.67	3.24	1.95	1.09	1.12	4.09	2.01	3.09	4.91
23, ...	3.99	3.14	11.88	6.52	3.38	1.77	0.94	1.29	4.19	6.76	2.79	4.41
24, ...	4.19	3.29	11.73	7.02	3.16	1.65	0.95	1.47	3.49	8.06	2.74	4.11
25, ...	4.04	3.49	8.08	6.68	2.66	1.50	0.87	3.15	2.74	8.84	2.74	3.81
26, ...	3.64	3.69	6.58	6.85	2.24	1.45	0.87	2.77	2.34	8.71	2.84	3.71
27, ...	3.29	....	5.88	5.12	1.98	1.37	0.82	2.27	1.91	7.58	2.94	3.86
28, ...	3.11	5.89	7.86	4.79	2.21	1.35	0.87	2.07	1.74	7.21	2.94	3.81
29, ...	....	5.69	10.68	5.63	2.21	1.30	0.89	2.95	1.74	6.86	2.94	3.66
30, ...	....	....	12.53	7.15	2.24	1.25	0.85	2.12	1.59	6.36	2.99	3.91
31, ...	3.29	....	13.40	....	2.21	1.20	0.77	‡1.75	....	5.46	....	5.81

*Chain stolen. †Creek frozen over. ‡Measurement with new chain. aIce breaking up.

KINZUA CREEK.

DESCRIPTION OF BASIN.

Kinzua creek, a tributary of the Allegheny river in Warren county, drain an area of approximately one hundred and eighty square miles. Rising in the center of McKean county, it follows a general westerly direction through a rough, sparsely settled area, covered partly with second growth timber, and very little farming being carried on along its course, to its mouth at Kinzua, Warren county, a distance of about 35 miles. The slope is steep and in general the stream flows in a deep, narrow valley between high mountain ridges. Of the many tributaries, the principal one is the South Branch. The headwaters of one of its tributaries are used for a water supply. The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since October 23, 1909, at Dewdrop, approximately three miles above the mouth.

OHIO BASIN—STATION NO. 3.

KINZUA CREEK AT DEWDROP, PENNA.

DESCRIPTION OF STATION.

This station was established on October 23, 1909, by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, and was discontinued November 20th, 1911. It was re-established by the Water Supply Commission on July 22, 1912. It is located on a single span, steel, through truss, highway bridge, three miles above the mouth.

The channel is straight for 300 feet above and 600 feet below. Both banks overflow at extreme high stages, low fields lying on either side. The bed of the stream is composed of rock and gravel and fairly permanent; good velocity with eddy at right bank during normal stages.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being top edge of left bridge seat, the stations being painted on the downstream handrail. A chain gage, with detached box, is fastened to the downstream side of the bridge, near left bank. The length of chain from bottom of weight to marker is 12.99 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is outer downstream corner of coping on left abutment, elevation 10.95 feet above gage datum. Bench Mark No. 2 is a square cut in stone on top of downstream end of right bridge seat, elevation 10.92 feet above gage datum. The gage is read once daily, except Sundays, by C. R. Morrison.

Since the establishment of this station, 16 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF KINZUA CREEK, AT DEWDROP, WARREN COUNTY, PA.

(Drainage area 171 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean veocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913.							
15	Mar. 31,	Boehringer & Knight.	98	368	2.96	3.77	1091	0.2 and 0.8 msmt.
16	Mar. 31,	Boehringer & Knight.	98	368	3.04	3.77	1118	Surface msmt.

DISCHARGE TABLE FOR KINZUA CREEK, AT DEWDROP, WARREN COUNTY, FROM JULY 22, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.00	5	.70	210	.40	904	.10	2084	.80	3629
.10	9	.80	238	.50	959	.20	2169	.90	3724
.20	13	.90	270	.60	1014	.30	2254	7.00	3819
.30	18	2.00	302	.70	1069	.40	2339	.10	3914
.40	24	.10	334	.80	1129	.50	2429	.20	4009
.50	30	.20	370	.90	1189	.60	2519	.30	4104
.60	38	.30	408	4.00	1254	.70	2609	.40	4199
.70	46	.40	446	.10	1319	.80	2699	.50	4299
.80	56	.50	488	.20	1384	.90	2789	.60	4399
.90	66	.60	530	.30	1454	6.00	2879	.70	4499
1.00	78	.70	572	.40	1524	.10	2969	.80	4604
.10	92	.80	618	.50	1599	.20	3059	.90	4714
.20	108	.90	664	.60	1674	.30	3154	8.00	4824
.30	126	3.00	710	.70	1754	.40	3249		
.40	144	.10	756	.80	1834	.50	3344		
.50	164	.20	804	.90	1914	.60	3439		
.60	186	.30	854	5.00	1999	.70	3534		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 4 discharge measurements made during 1911-1912-1913, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF KINZUA CREEK AT DEWDROP, WARREN COUNTY, PA.

1912.	JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1,	......	......	1.00	78	......	a750	2.00	302	2.40	446	......	a198
2,	......	......	0.98	76	......	a800	1.93	270	2.30	408	3.30	854
3,	......	......	1.45	154	3.50	959	1.82	244	......	a355	3.05	738
4,	......	......	......	a116	3.05	733	1.80	238	2.00	302	2.50	488
5,	......	......	1.00	73	2.75	595	1.70	210	1.95	286	245	467
6,	......	......	0.95	72	3.10	756	......	a198	1.85	254	3.20	804
7,	......	......	0.90	66	2.50	488	1.60	186	2.25	389	2.80	618
8,	......	......	0.90	66	......	a111	1.50	164	2.30	408	......	a542
9,	......	......	0.90	66	2.10	334	1.50	164	2.30	408	2.45	467
10,	......	......	0.98	76	1.95	286	1.60	186	......	a389	2.40	446
11,	......	......	......	a92	1.80	238	1.85	254	2.20	370	2.28	400
12,	......	......	1.20	108	1.80	238	1.70	210	2.19	366	2.15	352
13,	......	......	1.00	78	1.70	210	......	a187	2.15	352	2.00	302
14,	......	......	1.10	92	1.65	198	1.50	164	2.20	370	2.00	302
15,	......	......	0.90	66	......	a190	1.50	164	2.05	318	......	a294
16,	......	......	0.85	61	2.80	618	1.45	154	2.00	302	1.95	286
17,	......	......	0.80	56	2.20	370	1.43	150	......	a286	1.88	264
18,	......	......	......	a300	2.20	370	1.40	144	1.90	270	1.85	254
19,	......	......	2.00	302	2.00	302	1.76	224	1.82	244	1.90	270
20,	......	......	1.67	203	1.85	254	......	a194	1.81	241	1.80	238
21,	......	......	1.60	186	1.70	210	1.50	164	1.80	238	1.76	224
22,	1.09	91	1.50	164	......	a200	1.60	186	1.75	224	......	a194
23,	1.00	78	1.80	238	1.80	238	4.70	1750	1.70	210	1.50	164
24,	1.10	92	1.75	224	1.90	270	3.20	804	......	a217	1.70	210
25,	1.22	112	......	a356	2.00	302	3.22	814	1.75	224	1.68	205
26,	1.07	88	2.50	488	1.85	254	2.95	687	1.70	210	1.50	164
27,	1.01	79	3.80	1130	2.30	408	......	a608	1.65	198	1.60	186
28,	......	a79	2.60	530	2.00	302	2.60	530	......	a192	1.60	186
29,	1.01	79	3.99	1250	......	a301	2.50	488	1.60	186	......	a200
30,	0.99	77	2.90	664	1.99	299	2.40	446	1.65	198	2.22	378
31,	0.99	77	2.50	488	......	......	2.20	370	......	......	2.50	488

a Discharge estimated.

ESTIMATED MONTHLY DISCHARGE OF KINZUA CREEK, AT DEWDROP, WARREN COUNTY.

(Drainage area 171 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
August,	1250	56	256	1.497	1.726
September,	959	190	396	2.316	2.584
October,	1750	144	350	2.047	2.360
November,	446	186	295	1.725	1.924
December,	854	164	361	2.111	2.434

BROKENSTRAW CREEK.

DESCRIPTION OF BASIN.

Brokenstraw creek, a tributary of the Allegheny river, drains an area of approximately 324 square miles, 70 of which lie in New York State. Rising in Chatauqua county, New York, about five miles north of the Pennsylvania State line, it flows in a general southerly direction and enters Erie county, Pa., near its northeastern corner, and turning southeasterly passes into and through Warren county to its mouth at Irvineton, a distance of about 35 miles. This stream flows through a rolling, agricultural country, bordered by a wide valley, sparsely settled and considerably deforested. A few boroughs lie in the basin, and some farming villages. The flow of this stream is not rapid, the source lying at an elevation of 1,720 feet, and the mouth at 1,140 feet, the average slope per mile being 10 feet from the New York State line through Pennsylvania to its mouth. The upper watershed lies within the glacial area. There are many tributaries, Little Brokenstraw being the largest, and on the headwaters there are a few lakes, ponds and swamps. It is not used for water supply and very little power has been developed.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge of this creek has been measured since October 22, 1909, at Youngsville, Warren county, approximately 3 miles above its mouth.

OHIO BASIN—STATION NO. 4.

BROKENSTRAW CREEK AT YOUNGSVILLE, PENNA.

DESCRIPTION OF STATION.

This station was established on October 22nd, 1909, by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, and is located on a single span, steel, through-truss, highway and trolley bridge, at Youngsville, Warren Co., about 3 miles above the mouth of the creek.

The channel above the station curves gradually to the right, looking up-stream, with a riffle about 300 feet above the bridge, while below the station the channel is straight for 1,000 feet, with a riffle

400 feet below the bridge. The right bank is high and does not overflow, while the left bank overflows for a short distance under approach trestle at high stages. The bed of the creek is composed of clay and gravel, and is fairly permanent. The channel at this section is deep and quiet, and the flow mostly at right side in low stages.

Discharge measurements are made from the downstream side of the bridge during medium and high stages, and by wading at low stages. The initial point for soundings is top edge bridge seat, right abutment.

A 14-foot staff gage, graduated in feet and tenths, was spiked to a large pile on left bank, just above the bridge, but was subsequently removed to the right abutment, downstream side, where it is at present located. Bench Mark No. 1 is ring cut in top of upstream corner of right abutment on the outer edge near the date 1891 cut in stone; elevation 12.42 feet above zero of gage, which is arbitrary datum. The gage is read twice daily by W. F. Schnell, Youngsville, Pa.

Since the establishment of this station, 16 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission of Pennsylvania.

DISCHARGE MEASUREMENTS OF BROKENSTRAW CREEK, AT YOUNGSVILLE, WARREN COUNTY, PA.

(Drainage area 290 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913.							
15	Mar. 28,	Ryder, ...	123	1137	4.04	6.18	4598	Surface msmt.
16	Mar. 29,	Boehringer & Knight.	128	846	2.74	3.93	2319	0.2 and 0.8 msmt.

DISCHARGE TABLE FOR BROKENSTRAW CREEK, AT YOUNGSVILLE, WARREN COUNTY, FROM OCT. 31, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.00	50	.70	485	.40	1650	.10	3070	.80	5150
.10	62	.80	540	.50	1725	.20	3160	.90	5320
.20	75	.90	600	.60	1800	.30	3250	7.00	5490
.30	88	2.00	660	.70	1875	.40	3340	.10	5665
.40	101	.10	720	.80	1950	.50	3440	.20	5840
.50	115	.20	785	.90	2030	.60	3540	.30	6015
.60	133	.30	850	4.00	2110	.70	3640	.40	6190
.70	154	.40	915	.10	2190	.80	3740	.50	6365
.80	175	.50	985	.20	2270	.90	3850	.60	6540
.90	198	.60	1055	.30	2350	6.00	3970	.70	6715
1.00	224	.70	1125	.40	2440	.10	4100	.80	6890
.10	255	.80	1200	.50	2530	.20	4230	.90	7065
.20	287	.90	1275	.60	2620	.30	4370	8.00	7240
.30	320	3.00	1350	.70	2710	.40	4510		
.40	355	.10	1425	.80	2800	.50	4660		
.50	392	.20	1500	.90	2890	.60	4820		
.60	434	.30	1575	5.00	2980	.70	4980		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF BROKENSTRAW CREEK AT YOUNGSVILLE, WARREN COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	*3.70	1875	*1.50	392	2.40	915	7.85	6980	2.70	1120	0.70	154	0.40	101	0.30	88	5.40	3340	1.20	287	1.40	355	1.10	255
2, ...	*2.70	1120	*1.50	392	*1.90	600	8.10	7420	2.30	850	0.70	154	0.40	101	0.30	88	b5.45	3390	1.15	271	1.85	570	2.40	915
3, ...	*2.30	850	*1.50	392	*1.40	355	6.25	4300	1.80	540	0.70	154	0.40	101	0.40	101	5.40	3340	1.10	255	1.90	600	4.10	2190
4, ...	*1.75	512	*1.50	392	*1.20	287	4.50	2530	1.55	418	0.70	154	0.35	94	0.35	94	3.70	1830	1.00	224	1.75	512	4.00	2110
5, ...	*1.40	355	*1.50	392	*1.20	287	4.70	2710	1.35	338	0.70	154	0.35	94	0.30	88	3.20	1500	1.00	224	1.70	485	4.05	2150
6, ...	*1.20	287	*1.50	392	*1.20	287	5.60	3540	1.35	338	0.70	154	0.35	94	0.30	88	2.80	1200	0.90	198	1.60	434	4.10	2190
7, ...	*1.00	224	*1.50	392	*1.20	287	6.70	4980	1.45	374	0.70	154	0.35	94	0.30	88	2.20	785	0.80	175	1.60	434	4.20	2270
8, ...	*1.00	224	*1.50	392	*1.20	287	6.50	4660	1.40	355	0.70	154	0.35	94	0.30	88	1.60	434	0.80	175	1.85	570	3.10	1420
9, ...	*1.00	224	†	c390	*1.10	255	4.40	2440	1.35	338	0.70	154	0.30	88	0.60	133	1.20	287	0.70	154	2.10	720	1.90	600
10, ...	*1.00	224	†	c390	*1.00	224	3.10	1420	1.25	304	0.65	144	0.30	88	0.50	115	1.00	224	0.95	211	3.50	1720	*1.30	320
11, ...	*	e200	†	c390	*1.00	224	2.60	1060	1.10	255	0.65	144	0.30	88	0.40	101	0.85	186	0.95	211	2.70	1120	*1.10	255
12, ...	†	e200	†	c390	*1.00	224	2.35	882	1.00	224	0.60	133	0.30	88	0.35	94	0.80	175	0.95	211	2.05	690	*1.00	224
13, ...	†	e200	†	c390	a1.00	224	2.45	950	1.35	338	0.55	124	0.30	88	0.30	88	0.70	154	0.80	175	1.85	570	*1.00	224
14, ...	†	e200	†	c390	1.00	224	2.30	850	1.45	374	0.50	115	0.30	88	0.30	88	0.65	144	0.80	175	1.80	540	*1.00	224
15, ...	†	e200	†	c390	1.80	540	3.75	1910	1.45	374	0.60	133	0.30	88	0.30	88	0.60	133	0.80	175	1.65	460	*1.00	224
16, ...	†	e200	†	c390	3.90	2080	3.95	2070	1.45	374	0.70	154	0.30	88	0.30	88	1.10	255	0.80	175	1.55	418	a1.40	355
17, ...	†	e200	†	c390	4.70	2710	2.95	1310	1.90	600	0.70	154	0.30	88	0.30	88	0.95	211	0.70	154	1.45	374	1.30	320
18, ...	†	e200	*1.50	392	5.75	3690	2.45	950	1.90	600	0.65	144	0.30	88	1.30	320	0.85	186	0.70	154	1.40	355	1.40	355
19, ...	‡	e200	*1.50	392	6.20	4230	2.20	785	1.70	485	0.60	133	0.30	88	2.20	785	0.80	175	1.55	413	1.35	338	1.80	540
20, ...	†	e200	*1.50	392	7.65	6630	2.10	720	1.40	355	0.55	124	0.30	88	1.30	320	0.80	175	1.60	434	1.40	355	*1.70	485
21, ...	*3.00	1350	*1.50	392	6.10	4100	1.95	680	1.15	271	0.55	124	0.30	88	1.15	271	0.80	175	1.50	392	1.35	338	*1.60	434
22, ...	*2.50	985	*1.45	374	4.10	2190	1.70	485	1.05	240	0.50	115	0.25	82	1.00	224	0.80	175	1.40	355	1.25	304	*1.60	434
23, ...	*2.40	915	*1.40	355	3.30	1580	2.05	690	0.90	198	0.50	115	0.25	82	0.90	198	1.50	392	3.60	1800	1.20	287	*1.40	355
24, ...	*2.40	915	*1.40	355	3.00	1350	2.10	720	0.90	198	0.50	115	0.45	108	0.90	198	3.00	1350	4.85	2840	1.10	255	*1.30	320
25, ...	*2.00	660	*1.40	355	2.60	1060	1.85	570	0.90	198	0.50	115	0.40	101	0.85	186	2.50	985	4.83	2830	1.10	255	*1.20	287
26, ...	*1.50	392	a1.60	434	2.25	818	1.70	485	0.85	186	0.50	115	0.40	101	1.80	540	1.85	570	4.00	2110	1.10	255	*1.00	224
27, ...	*1.50	392	2.80	1200	2.20	785	1.55	418	0.80	175	0.50	115	0.40	101	3.00	1350	1.50	392	3.40	1650	1.10	255	*1.00	224
28, ...	*1.50	392	2.75	1160	2.60	1060	1.35	338	0.70	154	0.50	115	0.40	101	2.70	1120	1.20	287	2.60	1060	1.10	255	*1.00	224
29, ...	*1.50	392	2.70	1120	6.00	3970	2.80	1200	0.70	154	0.45	108	0.30	88	2.50	985	1.00	224	1.80	540	1.10	255	*1.00	224
30, ...	*1.50	392	......	....	6.75	5060	2.65	1090	0.70	154	0.40	101	0.30	88	2.40	915	0.95	211	1.50	392	1.10	255	a2.50	985
31, ...	*1.50	392	......	....	6.70	4980	......	....	0.70	154	......	....	0.30	88	2.00	660	......	....	1.40	355	......	....	3.05	1390

Notes.—*Ice at ledges. †Creek frozen. ‡Dynamited gorge. a Ice out of creek. b Max. 6.3 at 5:00 p. m.; 4370 sec. ft. c Interpolated. e estimated.

ESTIMATED MONTHLY DISCHARGE OF BROKENSTRAW CREEK, AT YOUNGSVILLE, WARREN COUNTY, PA.

(Drainage area 290 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	1875	....	486	1.676	1.932
February,	1200	....	440	1.517	1.636
March,	6630	224	1660	5.724	6.599
April,	7420	338	1970	6.793	7.579
May,	1120	154	356	1.228	1.416
June,	154	101	134	0.462	0.515
July,	108	82	92	0.317	0.365
August,	1350	88	312	1.076	1.241
September,	4370	133	764	2.634	2.938
October,	2840	154	606	2.090	2.410
November,	1720	255	478	1.648	1.839
December,	2270	224	733	2.528	2.915
The year,	7420	....	669	2.308	31.385

Note.—Creek frozen Jan. 11-20, incl., and Feb. 9-17, incl., discharge estimated.

TIONESTA CREEK.

DESCRIPTION OF BASIN.

Tionesta creek, one of the large tributaries of the Allegheny river, drains approximately 485 square miles in Warren, McKean and Forest counties. The main stream rises on the west slope of the Allegheny mountains in the southcentral part of Warren county, and flows in a northeasterly direction for approximately 13 miles to Clarendon, Warren county, where it turns and flows in a general southerly direction for approximately 13 miles to the Warren-Forest county line, thence flowing in a general southwesterly direction for approximately 32 miles to its mouth in the Allegheny river at Tionesta, Forest county, a total distance of approximately 58 miles.

The valley of the stream near its headwaters is fairly broad, the creek flowing through low, marshy land, but after it leaves Sheffield, it enters a gorge-like valley, with hills rising 500 feet to 600 feet on either side, to its mouth. The valleys in the lower reaches are farmed to a small extent, while on the adjoining hills is some virgin and second-growth timber. A large portion of the high ground is under cultivation.

There is considerable lumbering carried on in its drainage basin, and there are several saw mills along the course of the stream and its tributaries. There are also several small water power installations along this stream, some of which, however, have been abandoned. It is proposed to erect a 300-foot dam near the mouth of the creek, in connection with a proposed hydro-electric power plant, which will back water up almost to Sheffield.

The elevation of the creek at Saybrook, at the mouth of Four-Mile run, 18 miles below its source, is 1,348 feet above mean sea level, while at its mouth at Tionesta it is 1044 feet above mean sea level, a fall of 304 feet in a distance of approximately 40 miles, or at the rate of 7½ feet per mile.

There are no large streams entering the creek, although there are numerous small tributaries from the east and west. Several of the tributaries above Sheffield and Clarendon come from wooded hills, and are clear and pure.

The largest communities in its watershed are Nebraska, Sheffield, Clarendon, none of which, however, are of any considerable size.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since July 26th, 1912, at Butler Bridge, about 2 miles above Nebraska, Forest county, Penn'a.

OHIO BASIN—STATION NO. 5.

TIONESTA CREEK NEAR NEBRASKA, FOREST COUNTY.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 26th, 1912, and is located at Butler Bridge, a three span structure; two deck spans and one through truss steel span and is about two miles above Nebraska.

The channel above the station is straight for 200 feet, while below the station it is straight for 1,500 feet. The right and left banks are high, wooded and not subject to overflow. The bed is composed of gravel and boulders and is fairly permanent.

Discharge measurements are taken from the downstream side of the bridge; the initial point for soundings being right end of downstream hand-rail.

A sectional chain gage is fastened to the face of the wooden guard-rail. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a cross chiselled on the downstream side of the right pier, marked "B. M and W. S. C. of Pa;" elevation, 17.77 feet above gage datum. The length of chain from the bottom of the weight to marker is 32.82 feet. The gage is read once daily, by Mrs. P. S. Moore.

This station was established to replace the gaging station which was operated on this creek at Nebraska, the latter station being discontinued on account of the unreliability of the gage heights, which were influenced by a mill dam and tail race immediately at the station.

Since the establishment of this station two discharge measurements have been made. Owing to the insufficient number of discharge measurements no rating table for discharge has been published and only the discharge measurements and daily gage heights are given below.

DISCHARGE MEASUREMENTS OF TIONESTA CREEK, NEAR NEBRASKA, FOREST COUNTY, PA.

(Drainage area 420 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
1	1912. July 26,	Boehringer, ...	125	383	0.76	3.99	292	0.6 method.
2	1913. April 1,	Boehringer & Knight.	134	634	3.09	5.88	1958	0.2 and 0.8 method.

DAILY MEAN GAGE HEIGHTS OF TIONESTA CREEK NEAR NEBRASKA, FOREST COUNTY, PA.

	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
1912.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	....	3.8	6.4	4.2	4.6	3.9
2,	....	3.9	6.9	4.1	4.7	4.0
3,	....	4.1	6.9	4.0	4.6	5.6
4,	....	3.9	6.0	4.0	4.4	5.1
5,	....	3.8	5.5	3.9	4.4	4.8
6,	....	3.7	5.5	3.9	4.4	5.1
7,	....	3.6	5.2	3.8	4.5	5.5
8,	....	3.6	4.8	3.8	5.0	5.2
9,	....	3.6	4.6	3.8	5.0	5.1
10,	....	3.5	4.4	3.9	5.1	*5.0
11,	....	3.9	4.5	4.2	5.0	4.8
12,	....	3.9	4.3	4.0	4.9	4.6
13,	....	3.6	4.1	4.0	4.8	†6.5
14,	....	3.6	4.1	3.9	4.7	‡6.7
15,	....	3.5	4.0	3.9	4.7	‡6.8
16,	....	3.5	4.5	3.8	4.6	‡6.8
17,	....	3.5	4.0	3.8	4.5	†6.6
18,	....	3.5	4.3	3.8	4.4	a6.3
19,	....	5.1	4.5	3.9	4.4	6.1
20,	....	4.9	4.3	4.1	4.3	6.0
21,	....	4.7	4.3	4.1	4.8	5.8
22,	....	4.3	4.0	4.0	4.3	6.0
23,	....	4.1	4.0	4.4	4.2	6.0
24,	....	4.3	4.2	5.5	4.2	6.3
25,	....	4.1	4.3	5.5	4.2	†6.0
26,	4.0	6.0	4.2	5.8	4.2	6.0
27,	3.8	6.5	4.2	5.3	4.1	6.0
28,	3.7	5.4	4.2	5.2	4.0	5.7
29,	3.7	5.6	4.1	5.0	4.0	b5.4
30,	3.7	5.1	4.2	4.8	4.1	5.9
31,	3.7	4.8	....	4.7	....	‡7.6

Notes.—*Slush ice in creek. †Creek frozen over; measurement to top of ice. ‡Ice gorge. a Ice went out. b Ice breaking up above bridge.

OIL CREEK.

DESCRIPTION OF BASIN.

Oil creek, a tributary of the Allegheny river, drains an approximate area of 335 square miles in Erie, Crawford, Warren and Venango counties. It rises in Oil Creek Lake, Crawford county, which lake is fed by numerous streams and runs heading in Erie county; the East Branch of Oil creek rising in a large lake at Spartansburg, Crawford county, is also fed by numerous streams rising in Erie county. These two streams join at Centerville, Crawford county, the creek proper having a fall of 116 feet in a distance of 6 miles, while the East Branch has a fall of 150 feet in eight miles. From the junction of these streams Oil creek flows in a general southerly direction through Crawford and Venango counties to its mouth at Oil

City, a distance of 30 miles. From Centerville (elevation 1,275) to Oil City (elevation 985), the slope of the creek is at a uniform rate of 10 feet per mile. There are many tributaries, none, however, of any considerable size. The valley of Oil creek is wide and flat, the hills rising abruptly, and often with cliffs, from its flood plain. Its upper section lies in the glacial area. The valley is underlain with productive oil fields, farming and oil production being carried on throughout the basin. Its valley is largely deforested, and along its course lie numerous large boroughs and villages. The stream is used extensively for industrial water supply but no domestic supplies are obtained from it.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since Oct. 20, 1909, at Rouseville, about two and one-half miles above the mouth.

OHIO BASIN—STATION NO. 6.

OIL CREEK AT ROUSEVILLE, PA.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, on October 20th, 1909, and is located on a two-span, steel, through truss, highway bridge, about two and one-half miles above the mouth and one-half mile below Rouseville.

The channel above the station is straight for 200 feet, a trolley bridge crossing the same about 400 feet up the stream. The channel below the station is straight for 1,000 feet. The right bank is high and only overflows in extreme floods, while the left bank is high and not subject to overflow. The bed is composed of gravel and is fairly permanent. There is slight velocity at low stages.

Discharge measurements are made from the downstream side of the bridge and by wading at extreme low stages. The initial point for soundings is top edge, right bridge seat.

A standard chain gage is attached to the lower chord of the bridge on the downstream side, left span. The length of chain from the bottom of weight to the marker is 16.92 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is top chord at upstream end of stone-in bottom course at downstream corner of right abutment; elevation 1.46 feet above gage datum. Bench Mark No. 2 is bottom of iron bed plate on right abutment downstream truss (directly above gage) elevation 15.76 feet above gage datum. Prior to July 27th, 1912, readings were taken on a 14-foot staff gage bolted to the downstream face of the right abutment, placed on the same datum as the chain gage. The gage is read twice daily by C. H. Wright.

Since the establishment of this station, 21 discharge measurements have been made.

DISCHARGE MEASUREMENTS OF OIL CREEK, AT ROUSEVILLE, VENANGO COUNTY, PA.

(Drainage area 330 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
21	1913. Mar. 27,	Boehringer & Knight.	182	1315	6.70	5.96	8816	Surface measurement.

DISCHARGE TABLE FOR OIL CREEK, AT ROUSEVILLE, VENANGO COUNTY, FROM OCT. 20, 1909.

Gage, height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.40	33	.60	420	.80	2000	4.00	4080	.20	6580
.50	45	.70	495	90	2170	.10	4260	.30	6820
.60	60	.80	580	3.00	2340	.20	4450	.40	7080
.70	77	.90	675	.10	2510	.30	4640	.50	7360
.80	96	2.00	780	.20	2680	.40	4840	.60	7640
.90	118	.10	900	.30	2850	.50	5040	.70	7940
1.00	145	.20	1030	.40	3020	.60	5240	.80	8240
.10	175	.30	1170	.50	3195	.70	5460	.90	8540
.20	210	.40	1320	.60	3370	.80	5680	6.00	8840
.30	255	.50	1490	.70	3545	.90	5900		
.40	300	.60	1660	.80	3720	5.00	6120		
.50	355	.70	1830	.90	3900	.10	6340		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF OIL CREEK AT ROUSEVILLE, VENANGO COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1,	3.25	2760	......	240	......	280	4.45	4940	2.45	1400	0.85	107	0.70	77	0.78	92	0.98	140	0.87	111	1.47	338	0.85	107
2,	2.30	1170	......	240	......	280	4.75	5570	2.05	840	0.80	96	0.70	77	0.68	74	1.98	759	0.87	111	1.67	472	1.85	628
3,	1.95	728	......	240	......	280	4.50	5040	1.85	628	2.00	780	0.60	60	1.18	203	2.98	2310	0.87	111	1.57	400	1.55	388
4,	1.85	628	......	240	......	280	3.30	2850	1.65	458	1.55	388	0.70	77	0.88	114	1.98	759	0.87	111	1.57	400	1.75	538
5,	1.45	328	......	240	......	280	3.35	2940	1.45	328	1.05	160	0.70	77	0.78	92	1.68	480	0.87	111	1.57	400	1.45	328
6,	1.40	300	......	240	......	280	3.05	2420	1.75	538	1.00	145	0.80	96	0.68	74	1.58	407	0.77	90	1.57	400	3.15	2600
7,	1.30	255	......	240	......	280	3.15	2600	1.65	458	0.90	118	0.70	77	0.68	74	1.28	246	0.87	111	1.57	400	2.45	1400
8,	1.40	300	......	240	......	280	3.75	3630	1.60	420	0.80	96	0.80	96	0.68	74	1.28	246	0.87	111	2.47	1440	1.95	728
9,	1.40	300	......	240	......	280	3.05	2420	1.45	328	0.80	96	0.70	77	0.78	92	0.98	140	0.87	111	1.47	338	1.75	538
10,	1.40	300	......	240	......	280	2.60	1660	1.40	300	0.80	96	0.70	77	0.78	92	0.88	114	0.87	111	2.67	1780	1.55	388
11,	1.40	300	......	240	......	280	2.05	840	1.30	255	0.80	96	0.70	77	0.78	92	0.88	114	1.07	166	2.07	864	1.45	328
12,	*	300	......	240	......	280	2.00	780	1.45	328	0.70	77	0.80	96	0.78	92	0.88	114	0.97	137	1.97	748	1.15	192
13,	......	300	......	240	......	280	2.00	780	1.55	388	0.70	77	0.70	77	0.68	74	0.68	74	0.97	137	1.57	400	1.15	192
14,	......	300	......	240	......	280	1.90	675	1.55	388	0.80	96	0.80	96	0.68	74	0.73	83	0.87	111	1.57	400	1.15	192
15,	......	300	......	240	......	1100	3.75	3630	1.70	495	0.90	118	0.70	77	0.68	74	0.78	92	0.87	111	1.47	338	1.15	192
16,	......	300	......	240	......	2400	2.75	1920	1.70	496	1.00	145	0.80	96	0.58	57	1.08	169	0.87	111	1.47	338	1.15	192
17,	......	300	......	240	†3.50	3200	2.75	1920	1.80	580	1.00	145	0.70	77	0.58	57	0.98	140	0.87	111	1.47	338	1.25	232
18,	......	300	......	240	4.00	4080	2.30	1170	1.70	495	0.90	118	0.90	118	0.58	57	0.88	114	0.87	111	1.37	286	1.35	278
19,	......	300	......	240	3.80	3720	2.05	840	1.60	420	0.80	96	0.80	96	0.78	92	0.98	140	1.47	338	1.37	286	1.55	388
20,	......	300	......	240	4.50	5040	1.95	728	1.45	328	0.80	96	0.70	77	0.98	140	0.88	114	1.37	286	1.27	242	1.45	328
21,	......	300	......	240	3.60	3370	1.80	580	1.35	278	0.80	96	0.90	118	0.88	114	0.78	92	1.17	200	1.27	242	1.25	232
22,	......	300	......	240	2.80	2000	1.70	495	1.25	232	0.90	118	0.80	96	0.88	114	0.78	92	1.07	166	1.27	242	1.05	160
23,	......	300	......	240	2.05	840	2.00	780	1.20	210	0.80	96	0.70	77	0.78	92	1.08	169	1.97	748	1.07	166	0.95	132
24,	......	300	......	240	2.80	2000	1.80	580	1.20	210	0.80	96	0.90	118	0.88	114	2.28	1140	2.22	1060	1.07	166	1.15	192
25,	......	300	......	240	2.35	1240	1.70	495	1.05	160	0.80	96	1.00	145	0.88	114	1.68	480	2.27	1130	1.07	166	1.15	192
26,	......	300	......	240	2.20	1080	1.55	388	1.00	145	0.80	96	0.90	118	1.78	563	1.53	374	2.37	1280	1.07	166	‡1.35	278
27,	......	300	......	240	2.05	840	1.50	355	1.00	145	0.80	96	0.80	96	1.98	759	1.28	246	1.97	748	1.07	166	a1.15	192
28,	......	300	......	240	2.55	1580	1.40	300	1.00	145	0.80	96	0.70	77	1.78	563	1.28	246	1.57	400	0.97	137	a0.95	132
29,	......	300	......	240	4.55	5140	2.45	1400	1.00	145	0.70	77	0.70	77	1.68	480	0.98	140	1.57	400	0.97	137	a0.95	132
30,	......	300	......	....	4.80	5680	3.45	3110	0.90	118	0.70	77	0.70	77	1.18	203	0.98	140	1.47	338	0.97	137	†1.35	278
31,	......	300	......	....	4.75	5570	......	....	0.90	118	......	....	0.80	96	1.08	169	......	....	1.47	338	......	....	2.55	1580

*Creek frozen over Jan. 12-March 16, incl., and daily discharge estimated from Allegheny River at Kittanning and climatological records. †Ice went out. ‡Shore ice. a Ice around gorge, middle of channel open.

ESTIMATED MONTHLY DISCHARGE OF OIL CREEK AT ROUSEVILLE, VENANGO COUNTY, PA.

(Drainage area 330 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	431	1.306	1.506
February,	....	....	240	0.727	0.784
March,	5680	....	1700	5.152	5.939
April,	5570	300	1860	5.636	6.288
May,	1400	118	380	1.151	1.327
June,	780	77	136	0.412	0.459
July,	145	60	89	0.270	0.311
August,	759	57	164	0.497	0.573
September,	2310	74	329	0.997	1.113
October,	1280	90	307	0.930	1.072
November,	1780	137	411	1.245	1.389
December,	2600	107	441	1.336	1.540
The year,	....	....	541	1.638	22.301

Note.—Creek frozen over Jan. 12-Mar. 16, incl.; daily discharge estimated from Allegheny River at Kittanning and climatological records.

NORTH BRANCH OF FRENCH CREEK.

DESCRIPTION OF BASIN.

The North Branch of French creek, the largest tributary of French creek, rises in the southwestern corner of New York State, in numerous tributaries, draining an area of approximately 217 square miles, 114 of which lie in New York State, and flows in a general westerly direction into Erie county, Penn'a. and thence continues in a general southerly direction to its junction with the South Branch, at Leboeuf, Erie county, a distance of approximately 30 miles, the entire watershed lying north of the terminal morain.

The headwaters of this stream flow through broad, flat valleys, the side hills being low and rolling and covered with second growth timber. There are a few small lakes and swampy areas at the headwaters, the largest lake being Findley Lake, in New York State, near the New York-Pennsylvania state line. As the stream approaches its confluence with the south branch the hills become higher and the fall greater. Throughout the entire course it flows through a well populated, agricultural region. There are numerous small towns and boroughs in the watershed, the largest of which is Wattburg.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge of the stream has been measured since May 4th, 1910, at Kimmeytown, about six miles above its mouth.

OHIO BASIN—STATION NO. 7.

NORTH BRANCH OF FRENCH CREEK AT KIMMEYTOWN, PA.

DESCRIPTION OF STATION.

This station was established by the Flood Commission of Pittsburgh, on May 4th, 1910, who operated the same until February 1, 1912, when it was taken over by the Water Supply Commission of Pa. It is located on the steel, highway bridge, at Kimmeytown, Erie county, about five miles above the mouth of the creek.

The channel is straight for a distance of about 300 feet above and 600 feet below the station. The banks are both subject to overflow at extreme high stages. The bed of the creek is gravelly and permanent.

Discharge measurements are taken from the downstream side of the bridge, at ordinary stages, and by wading, at a section 200 feet above the bridge, at extreme low stages. The initial point for soundings is outer face of cassion at left end of bridge.

A chain gage is fastened to the floor on the downstream side of the bridge. The length of chain from the bottom of weight to the marker is 16.26 feet. The elevation of zero is 1235.70 feet. B. M. No. 1 is on west abutment, downstream side, top of cassion; elevation 1250.09 feet, or 14.39 feet above gage datum. The gage is read once daily by J. L. Carter.

Since the establishment of this station 13 discharge measurements have been made.

The data prior to 1912 was furnished by the Flood Commission of Pittsburgh, and will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF NORTH BRANCH FRENCH CREEK, AT KIMMEYTOWN, ERIE COUNTY, PA.

(Drainage area 190 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
13	1913. Mar. 29,	Boehringer & Knight.	157	557	2.77	4.38	1544	0.2 and 0.8 msmt.

DISCHARGE TABLE FOR NORTH BRANCH FRENCH CREEK, AT KIMMEYTOWN, ERIE COUNTY, FROM MAY 16, 1910.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.60	26	.10	414	.60	1120	.10	2060	.60	3320
.70	32	.20	450	.70	1180	.20	2140	.70	3420
.80	46	.30	490	.80	1240	.30	2220	.80	3520
.90	64	.40	530	.90	1300	.40	2300	.90	3630
1.00	86	.50	572	4.00	1360	.50	2380	7.00	3740
.10	108	.60	616	.10	1420	.60	2460	.10	3850
.20	132	.70	662	.20	1480	.70	2540	.20	3970
.30	160	.80	710	.30	1540	.80	2620	.30	4090
.40	188	.90	760	.40	1600	.90	2700	.40	4210
.50	216	3.00	810	.50	1660	6.00	2780	.50	4340
.60	246	.10	860	.60	1720	.10	2870	.60	4470
.70	276	.20	910	.70	1780	.20	2960	.70	4600
.80	310	30	960	.80	1850	.30	3050		
.90	344	.40	1010	.90	1920	.40	3140		
2.00	378	.50	1060	5.00	1990	.50	3230		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF NORTH BR. FRENCH CREEK AT KIMMEYTOWN, ERIE COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1,	3.69	1170	......	240	......	230	8.58	d5860	3.17	895	1.37	180	0.87	59	0.87	59	6.87	3600	1.60	246	1.75	293	b2.12	421
2,	3.39	1000	......	240	......	230	7.88	d4840	2.37	518	b1.47	208	0.77	42	0.87	59	5.97	2760	2.00	378	2.90	760	2.40	530
3,	2.69	657	......	240	......	230	5.08	2050	1.97	368	1.57	237	0.77	42	1.17	125	5.57	2440	1.70	276	b2.95	785	7.06	3800
4,	2.19	446	......	240	......	230	4.18	1470	1.77	300	1.37	180	0.77	42	b1.12	113	3.87	1280	1.60	246	3.00	810	4.30	1540
5,	1.79	307	......	240	......	230	5.08	2050	b1.77	300	1.27	152	0.77	42	1.07	101	2.67	648	1.50	216	2.85	735	3.06	835
6,	*	260	......	240	......	230	6.38	3120	1.77	300	1.17	125	0.77	42	0.87	59	2.07	403	b1.40	188	2.55	594	4.15	1450
7,	......	260	......	240	......	230	b6.43	3170	3.37	995	1.07	101	b0.77	42	0.87	59	2.00	378	1.30	160	3.20	910	3.70	1180
8,	......	260	......	240	......	230	6.48	3210	2.37	518	1.07	101	0.77	42	0.87	59	b1.80	310	b1.42	194	4.45	1630	b2.95	785
9,	......	260	......	240	......	230	4.28	1530	1.97	368	b1.02	90	0.77	42	0.87	59	1.60	246	b1.55	231	3.80	1240	2.20	450
10,	......	260	......	240	......	230	3.38	1000	1.77	300	0.97	79	0.77	42	0.87	59	1.40	188	b1.68	270	b3.48	1050	1.95	361
11,	......	260	......	240	......	230	2.88	750	1.57	237	0.97	79	0.77	42	b0.97	79	1.30	160	1.80	310	3.15	885	1.85	327
12,	......	260	......	240	......	230	2.58	607	b1.67	267	b0.92	68	0.77	42	1.07	101	1.30	160	1.70	276	2.70	662	1.70	276
13,	......	260	......	240	......	230	2.98	800	1.77	300	0.87	59	0.77	42	0.97	79	1.20	132	b1.55	231	2.25	470	1.65	261
14,	......	260	......	240	......	230	b3.58	1110	2.37	518	0.87	59	b0.87	59	0.87	59	1.20	132	1.40	188	2.30	490	2.10	414
15,	......	260	......	240	......	230	4.18	1470	2.37	518	0.87	59	0.97	79	1.07	101	b1.20	132	1.20	132	2.15	482	b1.92	351
16,	......	260	......	240	......	1840	4.78	1840	2.07	408	d1.50	216	0.87	59	0.97	79	1.20	132	1.20	132	2.05	396	1.75	293
17,	......	260	......	240	......	1840	3.48	1050	2.57	608	1.77	300	0.87	59	0.87	59	1.20	132	b1.57	237	b2.00	378	2.10	414
18,	......	260	......	240	......	1840	2.78	700	2.47	559	1.57	237	0.77	42	d2.00	378	1.20	132	b1.94	358	1.95	361	2.65	639
19,	......	260	......	240	c6.58	3300	2.58	607	b2.12	421	1.27	152	0.77	42	2.47	559	1.30	160	2.30	490	1.90	344	3.40	1010
20,	......	260	......	240	8.38	d5560	2.38	522	1.77	300	1.17	125	0.77	42	2.27	478	1.40	188	b2.15	482	1.65	261	2.65	639
21,	......	260	......	240	5.88	2680	b2.28	462	1.57	237	1.07	101	b0.82	50	1.77	300	2.10	414	2.00	378	1.65	261	2.35	510
22,	......	260	......	240	4.18	1470	2.08	407	1.47	208	0.97	79	0.87	59	1.47	208	b2.80	710	1.70	276	1.60	246	b2.25	470
23,	......	260	......	240	3.38	1000	3.48	1050	1.77	300	b0.97	79	0.77	42	1.37	180	3.50	1060	a7.15	3910	1.45	202	2.15	482
24,	......	260	......	240	b3.13	875	3.18	900	1.47	208	0.97	79	0.77	42	1.57	237	5.00	1990	6.70	3420	b1.55	231	2.30	490
25,	......	260	......	240	2.88	750	2.48	564	1.37	180	0.87	59	0.87	59	b1.77	300	3.70	1180	4.60	1720	1.65	261	2.05	396
26,	......	260	......	240	2.48	564	2.08	407	b1.27	152	0.87	59	0.97	79	1.97	368	2.60	616	5.00	1990	1.55	231	1.65	261
27,	......	260	......	240	2.48	564	1.98	371	1.17	125	0.87	59	0.87	59	4.97	1970	2.10	414	b4.10	1420	1.80	310	1.80	310
28,	......	260	......	240	3.08	850	b1.88	337	1.07	101	0.87	59	b0.87	59	3.87	1280	1.70	276	3.20	910	1.65	261	1.75	293
29,	......	260	......	240	5.58	2440	1.78	308	1.57	237	0.87	59	0.87	59	3.47	1040	b1.65	261	2.50	572	1.80	310	b1.80	310
30,	......	260	......	....	7.48	4310	4.28	1530	1.87	334	b0.87	59	0.87	59	3.47	1040	1.60	246	2.10	414	1.85	327	1.85	327
31,	......	260	......	....	6.58	3300	......	......	1.57	237	......	....	0.97	79	2.57	608	......	....	1.90	344	......	....	3.30	960

*Creek frozen. Daily discharge Jan. 6 to March 18, incl., estimated from Brokenstraw Creek at Youngsville. a Max. 7.80′ at 5:30 p. m.; 4780 sec. ft.
b Interpolated. c Ice gone. d Estimated.

ESTIMATED MONTHLY DISCHARGE OF NORTH BR. FRENCH CREEK AT KIMMEYTOWN, ERIE COUNTY.

(Drainage area 190 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	334	1.758	2.027
February,	....	....	240	1.263	1.362
March,	d5560	....	1180	6.211	7.160
April,	5860	303	1470	7.737	8.632
May,	995	101	365	1.921	2.215
June,	300	59	117	0.616	0.688
July,	79	42	51	0.268	0.309
August,	1970	59	331	1.742	2.008
September,	3600	182	696	3.663	4.087
October,	4730	132	663	3.489	4.023
November,	1680	202	538	2.832	3.159
December,	3800	251	666	3.505	4.041
The year,	....	....	554	2.917	39.711

Note.—d Estimated. Creek frozen over Jan. 6-Mar. 18, incl., and daily discharge estimated from Brokenstraw Creek at Youngsville.

CUSSEWAGO CREEK.

DESCRIPTION OF BASIN.

Cussewago creek, one of the largest tributaries of French creek, draining ninety-two square miles, rises in the southern part of Erie county and flows in a general southerly direction, through Erie and Crawford counties, for a distance of about twenty miles, to the parent stream opposite Meadville. This creek follows a tortuous course and the flow is sluggish throughout its entire length, passing through a wild, shallow, drift filled valley, the side hills of which often rise abruptly from the plains, with numerous small tributaries coming in from the east and the west. The watershed lies entirely within the glacial area, the hills being low, rolling, and largely deforested, while the basin is well populated by an agricultural community.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge of this creek has been measured since May 2nd, 1910, at Jones' Farm, above Meadville, Crawford county.

OHIO BASIN—STATION NO. 8

CUSSEWAGO CREEK AT JONES' FARM, ABOVE MEADVILLE.

DESCRIPTION OF STATION.

This station was established on May 2nd, 1910, by the Flood Commission of Pittsburgh, who operated the same until February 1, 1912, when it was taken over by the Water Supply Commission of Pa., who has maintained and operated the station since that date. It is located on the steel highway bridge near Jones' Farm, four and one-half miles above Meadville.

The channel above and below the station bends to the left. Both banks are subject to overflow at a gage height of about eight feet. The bed is soft and not permanent.

Discharge measurements are taken from the downstream side of the bridge, the initial point for soundings being the outer edge of the left abutment.

Originally a staff gage was attached to the right abutment, but as this was out of water at low stages, a chain gage was installed on June 6th, 1910. The length of the chain from the bottom of the weight to the marker is 14.83 ft. The elevation of zero is 1071.77 feet. Bench Mark No. 1 is on top of upstream side of left abutment; elevation 1085.40 feet, or 13.63 feet above gage datum. The gage is read once daily by J. E. Hofius.

This is not an entirely satisfactory location for a station, but no better point could be found on the creek, as the same conditions prevail throughout its whole length.

Since the establishment of this station, twelve discharge measurements have been made.

The data prior to 1912, which was furnished by the Flood Commission of Pittsburgh, will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CUSSEWAGO CREEK, NEAR MEADVILLE, CRAWFORD COUNTY, PA.

(Drainage area 90 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
12	1912 Dec. 9	Boehringer, ...	54	118	0.95	3.70	112	Surface msmt.

DISCHARGE TABLE FOR CUSSEWAGO CREEK, NEAR MEADVILLE, CRAWFORD COUNTY, FROM MAY 3, 1910.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.50	2	.60	48	.70	166	.80	335	.90	686
.60	3	.70	53	.80	172	.90	346	9.00	709
.70	4	.80	58	.90	179	7.00	357	.10	732
.80	5	.90	63	5.00	186	.10	368	.20	756
.90	6	3.00	68	.10	193	.20	380	.30	780
1.00	7	.10	73	.20	200	.30	392	.40	806
.10	8	.20	78	.30	207	.40	405	.50	833
.20	9	.30	83	.40	214	.50	419	.60	861
.30	10	.40	88	.50	221	.60	434	.70	890
.40	12	.50	94	.60	228	.70	450	.80	920
.50	14	.60	100	.70	236	.80	466	.90	950
.60	16	.70	106	.80	244	.90	483	10.00	980
.70	18	.80	112	.90	252	8.00	501	.10	1010
.80	20	.90	118	6.00	260	.10	519	.20	1040
.90	23	4.00	124	.10	268	.20	538	.30	1070
2.00	26	.10	130	.20	276	.30	558	.40	1100
.10	29	.20	136	.30	285	.40	578	.50	1130
.20	32	.30	142	.40	294	.50	599		
.30	35	.40	148	.50	304	.60	620		
.40	39	.50	154	.60	314	.70	641		
.50	43	.60	160	.70	324	.80	663		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CUSSEWAGO CREEK NEAR MEADVILLE, CRAWFORD COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	7.53	424	....	135	......	110	9.08	727	6.17	274	1.96	25	0.66	4	0.85	6	1.80	20	1.45	13	2.88	62	2.58	47
2, ...	7.93	488	....	135	......	110	9.18	751	3.77	110	1.56	15	0.68	4	0.80	5	1.60	16	1.55	15	3.28	82	3.18	77
3, ...	7.63	439	....	135	......	110	9.48	828	2.92	64	4.36	148	0.61	3	0.95	6	2.60	48	1.55	15	4.18	135	6.18	274
4, ...	4.23	138	....	135	......	110	8.98	704	2.37	38	4.56	158	0.66	4	0.85	6	3.00	68	1.55	15	4.68	165	6.98	355
5, ...	*3.43	90	....	135	......	110	8.58	616	2.07	28	2.46	41	0.56	3	0.85	6	2.30	35	1.50	14	4.48	153	5.28	206
6, ...	†	125	....	135	......	110	8.88	574	2.17	31	1.96	25	0.56	3	0.80	5	1.90	23	1.35	11	3.98	123	5.88	213
7, ...	......	125	....	135	......	110	8.38	574	5.07	191	1.86	22	0.66	4	0.75	4	2.10	29	1.35	11	3.78	111	6.98	355
8, ...	......	125	....	135	......	110	8.28	554	3.67	104	1.26	10	0.56	3	0.75	4	1.85	22	1.55	15	5.78	242	6.18	274
9, ...	......	125	....	135	......	110	8.68	637	2.67	52	1.26	10	0.66	4	0.90	5	1.40	12	1.25	10	6.08	266	4.43	150
10, ...	......	125	....	135	......	110	7.58	431	2.27	34	1.06	8	0.66	4	0.95	6	1.20	9	1.25	10	6.18	274	4.08	129
11, ...	......	125	....	135	......	110	4.28	141	2.02	27	1.06	8	0.66	4	1.30	10	1.10	8	1.65	17	6.68	322	3.20	78
12, ...	......	125	....	135	......	110	3.58	99	2.27	34	1.06	8	0.66	4	2.35	37	1.10	8	1.55	15	5.58	227	3.20	78
13, ...	......	125	....	135	......	110	3.33	84	2.82	59	1.11	8	0.66	4	1.65	17	1.00	7	1.85	22	5.28	206	*2.95	66
14, ...	......	125	....	135	......	110	3.58	99	2.97	66	1.06	8	0.76	5	1.35	11	0.95	6	1.55	15	3.38	87	2.60	48
15, ...	......	125	....	135	......	110	6.88	292	4.17	134	0.86	6	0.66	4	1.05	8	0.90	6	d1.47	13	3.58	99	2.30	35
16, ...	......	125	....	135	......	980	7.68	447	3.87	116	1.26	10	0.66	4	0.90	6	0.90	6	1.39	12	3.18	77	2.60	48
17, ...	......	125	....	135	......	980	8.38	574	5.17	198	2.11	29	0.66	4	0.80	5	0.85	6	1.14	8	4.18	135	3.45	91
18, ...	......	125	....	135	......	980	5.48	220	5.87	250	1.86	22	0.71	4	0.80	5	1.00	7	1.34	11	4.08	129	4.05	127
19, ...	......	125	....	135	......	980	4.63	162	4.07	128	1.66	17	0.68	4	0.75	4	0.95	6	2.94	65	3.58	99	4.30	142
20, ...	......	125	....	135	†10.20	1040	4.08	129	2.97	66	1.26	10	0.68	4	0.75	4	1.20	9	5.14	196	3.18	77	4.00	124
21, ...	......	125	....	135	9.80	920	3.28	82	2.37	38	1.16	9	0.61	3	0.96	6	1.10	8	4.64	162	2.98	67	3.60	100
22, ...	......	125	....	135	9.30	780	2.88	62	2.17	31	1.16	9	0.76	5	1.20	9	1.00	7	3.04	70	2.88	62	*2.80	58
23, ...	......	125	....	135	8.40	578	3.18	77	1.97	25	1.16	9	0.61	3	1.05	8	1.60	16	6.64	318	2.68	52	3.25	80
24, ...	......	125	....	135	7.90	483	3.08	70	1.77	19	0.96	7	0.71	4	0.96	6	4.40	148	10.64	c1170	2.58	47	2.40	39
25, ...	......	125	....	135	8.10	519	2.58	47	1.57	15	0.76	5	0.80	5	1.15	8	5.00	186	9.84	982	2.58	47	2.30	35
26, ...	......	125	....	135	8.25	548	2.38	36	1.47	13	0.76	5	0.80	5	1.25	10	3.50	94	9.44	817	2.58	47	*2.50	48
27, ...	......	125	....	135	7.50	419	2.18	31	1.27	10	0.86	6	0.90	6	5.20	200	2.50	43	9.34	790	2.58	47	2.30	35
28, ...	......	125	....	135	6.90	346	2.08	27	1.27	10	0.86	6	0.80	5	5.85	248	2.20	32	7.14	373	2.68	52	2.40	39
29, ...	......	125	....	135	8.20	538	3.68	105	1.92	24	0.81	5	0.80	5	4.10	180	1.80	20	6.54	308	2.58	47	*2.55	46
30, ...	......	125	....	......	10.50	1130	6.38	292	3.17	76	0.76	5	0.70	4	2.75	56	1.50	14	3.19	78	2.58	47	b2.50	43
31, ...	......	125	....	......	9.40	806	....	......	2.57	46	....	......	0.80	5	2.30	35	....	....	3.39	88	....	......	a6.28	279

*Partly frozen. †Creek frozen over Jan. 6-March 19, inclusive, and daily discharge estimated from Brokenstraw Creek at Youngsville. a Ice broke. b Ice breaking. c Estimated. d Interpolated.

ESTIMATED MONTHLY DISCHARGE OF CUSSEWAGO CREEK, NEAR MEADVILLE, CRAWFORD COUNTY.

(Drainage area 90 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	156	1.733	1.998
February,	....	....	135	1.500	1.618
March,	....	....	441	4.900	5.649
April,	828	27	316	3.511	3.917
May,	274	10	75	0.833	0.960
June,	158	5	22	0.244	0.272
July,	6	3	4	0.044	0.051
August,	248	4	28	0.311	0.358
September,	186	6	31	0.344	0.383
October,	c1170	8	181	2.011	2.318
November,	322	47	120	1.333	1.487
December,	256	35	120	1.333	1.537
The year,	....	....	136	1.508	20.548

Note.—c Estimated. Creek frozen over Jan. 6-March 19, inclusive, and daily discharge estimated from Brokenstraw Creek at Youngsville.

FRENCH CREEK.

DESCRIPTION OF BASIN.

French creek, in northwestern Pennsylvania, is one of the largest feeders of the Allegheny river, draining approximately 1,180 square miles, of which about 45 lie in New York State. It rises in the plateau in the southwestern corner of New York State, and flows approximately 25 miles southwesterly to the Pennsylvania line, crossing it into Erie county, Penn'a., 17 miles south of Lake Erie. From this point the stream continues in a general southwesterly direction through Erie and Crawford counties, cutting across the northeast corner of Mercer county into Venango, it follows a southeasterly course to its mouth at Franklin, the total length being about 100 miles. This stream throughout its entire length flows through a well inhabited, agricultural country, almost deforested, and containing in its basin many important and thriving communities. In general this stream flows through a broad valley, bounded by rolling hills and is tortuous in its course, flowing slowly with a gentle slope, often through long deep pools. From where it enters Venango county, however, to its mouth, a distance of 12½ miles, the fall is steeper, often broken by rapids, the hills on either side being higher. The source of French creek lies at an approximate elevation of 1,700 feet, and to LeBouef, 12 miles below the Pennsylvania State line, it falls at the rate of 14 feet per mile; thence to the Mercer-Venango county line, a distance of 50 miles, the rate is about 3 feet per mile, and from this point to the mouth, approximately 12 miles the rate of fall is 8 feet per mile. All but a small section of this basin near the mouth, lies within the glacial area, and at Cambridge Springs, where the valley of the creek for about eight miles above and below the town is extremely broad and flat, is said to have been formerly the bed of a large glacial lake. There are many mineral springs in this section of the drainage basin. Throughout the entire drainage area of French creek are numerous lakes, ponds and swamps from which the tributaries of the stream emanate. The Conneaut Lake, said to be the largest in Pennsylvania, lies in this watershed. The principal tributaries are—South Branch, Le Boeuf, Conewago creek, Conneautee creek, Muddy creek, Conneaut creek, Woodcock creek and Big Sugar creek. Numerous domestic and industrial water supplies are obtained from French creek and its tributaries. This creek at one time was extensively used by grist and flouring mills for power purposes, all but a few of these plants have been abandoned. At one period a state canal followed the lower portion of this stream.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since April 29, 1908, at Carlton, about 13 miles above the mouth.

OHIO BASIN—STATION NO. 9.

FRENCH CREEK AT CARLTON, PENNA.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on April 29th, 1908, and is located on a two-span, steel, through truss, highway bridge, near the Erie Railroad Station at Carlton.

The channel above and below the station is a gradual curve to the left, there being an old dam 800 feet upstream and a dam a mile and one-half downstream. The right bank is high and not subject to overflow, while the left bank is low and water passes around for a width of 400 feet, being several feet deep. This low section is about eight feet below the floor of the bridge. The bed is of sand, gravel and boulders and is permanent. There are a few trees and bushes in the channel near the left bank.

Discharge measurements are made from the downstream side of the bridge and by wading during extreme low stages. The initial point for soundings is end of upper angle of downstream handrail at right bank.

A ten-foot staff gage is fastened to the downstream face of the pier. The elevation of zero is arbitrary datum. Bench Mark No. 1 is right hand, downstream corner of center pier coping; elevation 17.58 feet above gage datum. The gage is read twice daily by E. E. Dean.

Since the establishment of this station, 27 discharge measurements have been made. No discharge measurements have been made since the 1910-11 report. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE TABLE FOR FRENCH CREEK, AT CARLTON, MERCER COUNTY, FROM APRIL 29, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
—.10	75	.40	1300	.90	4350	.40	8720	.90	14960
0.00	90	.50	1390	5.00	4500	.50	8920	10.00	15300
.10	105	.60	1480	.10	4650	.60	9120	.10	15670
.20	125	.70	1570	.20	4800	.70	9320	.20	16070
.30	145	.80	1670	.30	4960	.80	9520	.30	16470
.40	170	.90	1775	.40	5120	.90	9720	.40	16880
.50	195	3.00	1880	.50	5280	8.00	9920	.50	17300
.60	220	.10	1985	.60	5450	.10	10120	.60	17730
.70	250	.20	2095	.70	5620	.20	10330	.70	18180
.80	280	.30	2210	.80	5790	.30	10550	.80	18630
.90	320	.40	2325	.90	5960	.40	10780	.90	19100
1.00	365	.50	2445	6.00	6130	.50	11010	11.00	19600
.10	410	.60	2565	.10	6300	.60	11250	.10	20100
.20	460	.70	2685	.20	6480	.70	11500	.20	20600
.30	520	.80	2810	.30	6660	.80	11750	.30	21100
.40	580	.90	2940	.40	6840	.90	12000	.40	21600
.50	640	4.00	3070	.50	7020	9.00	12250	.50	22100
.60	705	.10	3200	.60	7200	.10	12520	.60	22650
.70	770	.20	3340	.70	7380	.20	12800	.70	23200
.80	835	.30	3480	.80	7560	.30	13100	.80	23800
.90	905	.40	3620	.90	7740	.40	13400	.90	24400
2.00	980	.50	3760	7.00	7930	.50	13700	12.00	25000
.10	1055	.60	3900	.10	8120	.60	14000		
.20	1135	.70	4050	.20	8320	.70	14300		
.30	1215	.80	4200	.30	8520	.80	14620		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF FRENCH CREEK AT CARLTON, MERCER COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAYS.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	5.90	5960	....	950	......	2100	9.68	14200	4.85	4280	1.62	718	0.30	145	0.50	195	2.85	1720	1.64	781	2.84	1710	1.88	891
2, ...	5.15	4720	....	950	......	2100	10.20	16100	3.90	2940	1.45	610	0.30	145	0.50	195	3.60	2560	1.59	698	2.80	1670	2.08	1040
3, ...	4.40	3620	....	950	......	2100	10.55	17500	3.20	2100	3.10	1960	0.30	145	1.00	365	5.65	5540	1.85	870	3.15	2040	4.60	3900
4, ...	3.40	2320	....	950	......	2100	9.45	13600	2.66	1530	2.70	1570	0.30	145	1.00	365	6.05	6220	1.66	744	3.50	2440	5.40	5120
5, ...	2.50	1890	....	950	......	2100	8.10	10100	2.46	1350	2.30	1220	0.30	145	0.90	320	4.55	3830	1.46	616	3.55	2500	5.00	4500
6, ...	1.98	965	....	950	......	2100	7.50	8920	2.25	1180	1.90	905	0.34	155	0.80	280	3.40	2320	1.25	490	3.70	2680	5.10	4650
7, ...	1.90	905	....	950	......	2100	7.70	9320	2.70	1570	1.50	640	0.39	163	0.74	262	2.82	1690	1.26	496	3.45	2380	5.70	5620
8, ...	1.90	905	....	950	......	2100	8.15	10200	2.65	1520	1.10	410	0.40	170	0.70	250	2.55	1440	1.20	460	4.95	4420	5.00	4500
9, ...	1.90	905	....	950	......	2100	7.60	9120	2.44	1340	0.90	320	0.40	170	0.70	250	2.00	980	1.20	460	5.31	4980	3.75	2750
10, ...	1.90	905	....	950	......	2100	5.45	5200	2.22	1150	0.80	280	0.40	170	1.00	365	1.74	796	1.20	460	5.34	5020	3.00	1880
11, ...	1.90	905	....	950	......	2100	4.75	4120	1.98	965	0.76	268	0.40	170	0.90	320	1.46	616	1.65	738	5.15	4720	2.80	1670
12, ...	1.98	965	....	950	......	2100	3.90	2940	2.02	995	0.73	259	0.58	215	0.95	342	1.28	508	1.76	809	4.20	3340	2.45	1840
13, ...	2.10	1060	....	950	......	2100	3.55	2500	2.15	1100	0.66	238	0.49	192	1.15	435	1.14	430	1.56	679	3.75	2750	2.28	1200
14, ...	*	970	....	950	......	2100	3.35	2270	2.75	1620	0.65	235	0.44	180	0.96	347	1.08	378	1.35	550	3.48	2420	2.05	1020
15, ...	....	970	....	950	......	2100	5.95	6040	3.10	1960	0.80	280	0.36	160	0.85	300	0.96	347	1.16	440	3.25	2150	2.30	1220
16, ...	....	970	....	950	‡8.33	10600	6.50	7020	3.20	2100	0.95	312	0.31	148	0.71	253	1.25	490	1.10	410	2.96	1840	2.30	1220
17, ...	....	970	....	950	6.85	7650	5.85	5880	3.60	2560	1.20	460	0.30	145	0.68	229	1.32	532	1.08	401	2.78	1650	2.55	1440
18, ...	....	970	....	950	7.85	9620	4.70	4050	3.65	2620	1.35	550	0.30	145	0.60	220	1.24	484	1.00	365	2.66	1530	2.95	1830
19, ...	....	970	....	950	9.20	12800	4.00	3070	3.20	2100	1.30	520	0.30	145	0.85	300	1.18	450	1.15	435	2.56	1440	3.60	2560
20, ...	....	970	....	950	10.45	17100	3.60	2560	2.60	1480	0.98	356	0.30	145	2.55	1440	1.08	401	2.70	1570	2.48	1370	3.50	2440
21, ...	....	970	....	950	10.60	17700	3.25	2150	2.38	1280	0.88	312	0.34	155	2.55	1440	1.15	435	3.00	1880	2.38	1280	3.00	1880
22, ...	....	970	....	950	9.55	13800	3.00	1880	2.10	1060	0.80	280	0.49	192	2.05	1020	1.70	770	2.40	1300	2.29	1210	2.40	1300
23, ...	....	970	....	950	7.18	8280	3.00	1880	1.92	920	0.80	280	0.42	175	1.85	870	2.15	1100	4.70	4050	2.12	1070	2.05	1020
24, ...	....	970	....	950	6.75	7470	3.60	2560	1.82	849	0.78	274	0.50	195	1.80	835	5.00	4500	7.50	8920	1.80	835	2.32	1230
25, ...	....	970	....	950	6.00	6120	3.24	2140	1.68	757	0.71	253	0.80	280	2.15	1100	5.32	4990	7.95	9820	1.80	835	a2.35	1260
26, ...	....	970	....	950	5.20	4800	2.90	1780	1.52	653	0.64	232	0.80	280	1.80	835	4.15	3270	7.80	9530	1.80	835	b2.00	980
27, ...	....	970	....	950	4.85	4280	2.52	1410	1.37	562	0.56	210	0.75	265	3.85	2830	3.22	2120	6.80	7560	1.80	835	2.00	980
28, ...	....	970	†	950	5.30	4960	2.38	1280	1.23	472	0.48	190	0.68	244	5.20	4800	2.60	1480	5.60	5450	1.80	835	1.92	920
29, ...	....	970	....	950	7.70	9820	3.20	2100	1.14	430	0.40	170	0.57	212	4.30	3480	2.12	1070	4.50	3760	1.80	835	b1.85	870
30, ...	....	970	....	......	9.60	12200	4.90	4350	1.70	770	0.34	155	0.50	195	3.95	3000	1.85	870	3.50	2440	1.80	835	2.15	1100
31, ...	....	970	....	......	9.60	14000	......	......	1.85	870	....	......	0.50	195	3.50	2440	....	......	3.05	1980	....	......	4.50	3760

*Creek frozen over, and daily discharge Jan. 14-March 15, inclusive, estimated from Allegheny River at Kittanning and climatological records. †Ice moved and gorged below bridge. ‡Ice went out. a Ice at gage. b Ice at gage and slush ice running.

ESTIMATED MONTHLY DISCHARGE OF FRENCH CREEK, AT CARLTON, MERCER COUNTY.

(Drainage area 1,070 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	1390	1.299	1.498
February,	....	....	950	0.888	0.958
March,	17700	....	6200	5.794	6.680
April,	17500	1280	5870	5.486	6.121
May,	4280	430	1450	1.355	1.562
June,	1960	155	484	0.452	0.504
July,	280	146	180	0.168	0.194
August,	4800	195	959	0.896	1.033
September,	6220	347	1740	1.626	1.814
October,	9820	365	2230	2.084	2.403
November,	5020	835	2080	1.944	2.169
December,	5620	870	2130	1.991	2.295
The year,	....	....	2140	1.999	27.231

Note.—Creek frozen over Jan. 14-March 15, inclusive, and daily discharge estimated from Allegheny River at Kittanning and climatological records.

SUGAR CREEK.

DESCRIPTION OF BASIN.

Sugar creek, one of the largest tributaries of French creek, rises in two branches in the southeast corner of Crawford county, Penn'a., and flows in a general southerly direction, with numerous large tributaries from the east and west, draining approximately 173 square miles, to its mouth at Sugar Creek Station, Venango county, Pa., a distance af approximately twenty miles. It flows through a well populated, agricultural region, the side hills being low and rolling and the valleys being wide and flat. There are numerous small villages in the watershed, the largest of which is Cooperstown borough. The production of oil is extensive throughout the valley.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge of this stream has been measured since May 6th, 1910, at Wyattville, about three miles above the mouth.

OHIO BASIN—STATION NO. 10.

SUGAR CREEK AT WYATTVILLE, PENNA.

DESCRIPTION OF STATION.

This station was established by the Flood Commission of Pittsburgh, on May 6th, 1910, who operated the same until Feb. 1, 1912, when it was taken over by the Water Supply Commission of Pa., and is located on the steel highway bridge at Wyattville, Venango county, three miles above the mouth of the creek.

The channel is straight for a distance of about 600 feet above and 1,500 feet below the station. At low water a pool is formed, owing to the flat slope of the creek bottom, which is gravelly and permanent. The right bank is high and does not overflow, while the left bank overflows only at extreme high water.

Discharge measurements are taken from the downstream side of the bridge, at ordinary stages, and by wading at a section ¼ mile below the bridge at low stages. The initial point for soundings is the face of left abutment.

A chain gage is attached to the bridge, the length of chain from the bottom of the weight to the marker being 13.83 feet. The elevation of zero is 1050.96 feet. B. M. No. 1 is on top of left abutment, downstream side of bridge; elevation 1062.48 feet or 11.52 feet above zero of gage. The gage is read once daily by T. G. Wyatt.

Since the establishment of this station, 9 discharge measurements have been made.

The data prior to 1912, which was furnished by the Flood Commission of Pittsburgh, will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF SUGAR CREEK, AT WYATTVILLE, VENANGO COUNTY, PA.

(Drainage area 160 square miles.

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
9	1913 April 2	Boehringer and Knight	86	400	1.10	2.80	440	0.2 and 0.8 msmt.

DISCHARGE TABLE FOR SUGAR CREEK, AT WYATTVILLE, VENANGO COUNTY, FROM MAY 7, 1910.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.00	10	.10	115	.20	683	.30	1175	.40	2450
.10	11	.20	142	.30	748	.40	1555	.50	2540
.20	13	.30	177	.40	813	.50	1640	.60	2630
.30	16	.40	220	.50	880	.60	1730	.70	2720
.40	21	.50	268	.60	950	.70	1820	.80	2810
.50	28	.60	320	.70	1020	.80	1910	.90	2900
.60	37	.70	375	.80	1090	.90	2000	6.00	2990
.70	47	.80	432	.90	1165	5.00	2090		
.80	59	.90	491	4.00	1240	.10	2180		
.90	75	3.00	555	.10	1315	.20	2270		
2.00	94	.10	619	.20	1395	.30	2360		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SUGAR CREEK, AT WYATTVILLE, VENANGO COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.20	683	....	120	....	140	4.00	1240	2.90	491	1.70	47	1.50	28	1.60	37	1.80	59	1.80	59	2.00	94	1.70	47
2, ...	3.00	555	....	120	....	140	4.10	1820	2.70	375	1.80	59	1.50	28	1.60	37	1.80	59	1.80	59	2.00	94	2.10	115
3, ...	2.80	432	....	120	....	140	3.70	1020	2.50	268	1.80	59	1.50	28	1.80	59	2.40	220	1.80	59	2.00	94	2.10	115
4, ...	2.30	177	....	120	....	140	3.30	748	2.30	177	1.80	59	1.50	28	1.60	37	2.30	177	1.70	47	1.80	59	2.00	94
5, ...	....	150	....	120	....	140	3.00	555	2.50	268	1.80	59	1.40	21	1.60	37	2.20	142	1.70	47	1.80	59	2.10	115
6, ...	....	150	....	120	....	140	2.90	491	2.30	177	1.80	59	1.40	21	1.60	37	2.20	142	1.70	47	1.80	59	2.20	142
7, ...	....	150	....	120	....	140	4.00	1240	2.30	177	1.70	47	1.40	21	1.60	37	2.10	115	1.60	37	2.00	94	2.10	115
8, ...	....	150	....	120	....	140	3.20	683	2.30	177	1.70	47	1.40	21	1.60	37	2.00	94	1.50	28	2.20	142	2.10	115
9, ...	....	150	....	120	....	140	3.00	555	2.20	142	1.70	47	1.40	21	1.60	37	1.80	59	1.50	28	2.40	220	2.10	115
10, ...	....	150	....	120	....	140	2.90	491	2.20	142	1.70	47	1.40	21	1.60	37	1.70	47	1.60	37	2.20	142	2.10	115
11, ...	....	150	....	120	....	140	2.80	432	2.10	115	1.70	47	1.40	21	1.60	37	1.70	47	2.00	94	2.20	142	2.10	115
12, ...	....	150	....	120	....	140	2.80	432	2.10	115	1.60	37	1.50	28	1.60	37	1.70	47	2.10	115	2.20	142	2.00	94
13, ...	....	150	....	120	....	140	3.10	619	2.30	177	1.60	37	1.50	28	1.60	37	1.70	47	2.00	94	2.20	142	2.00	94
14, ...	....	150	....	120	....	140	3.20	683	2.40	220	1.60	37	1.50	28	1.60	37	1.70	47	1.90	75	2.20	142	2.00	94
15, ...	....	150	....	120	....	1050	4.90	2000	2.50	268	1.60	37	1.50	28	1.60	37	1.90	75	1.90	75	2.00	94	2.00	94
16, ...	....	150	....	120	....	1050	4.10	1820	2.70	375	1.70	47	1.50	28	1.60	37	1.80	59	1.90	75	2.00	94	2.00	94
17, ...	....	150	....	120	....	1050	3.40	813	2.90	491	1.70	47	1.50	28	1.60	37	1.80	59	1.90	75	2.00	94	2.00	94
18, ...	....	150	....	120	3.90	1165	2.70	375	2.80	432	1.70	47	1.50	28	1.60	37	1.80	59	1.90	75	2.00	94	1.90	75
19, ...	....	150	....	120	3.80	1090	2.50	268	2.50	268	1.70	47	1.70	47	1.60	37	1.80	59	2.20	142	2.00	94	1.90	75
20, ...	....	150	....	120	3.50	880	2.30	177	2.20	142	1.70	47	1.70	47	1.60	37	1.80	59	1.80	59	1.80	59	1.90	75
21, ...	....	150	....	120	3.70	1020	2.20	142	2.20	142	1.80	59	1.60	37	1.60	37	1.80	59	1.80	59	1.80	59	1.90	75
22, ...	....	150	....	120	3.70	1020	2.20	142	2.20	142	1.70	47	1.60	37	1.60	37	1.80	59	1.80	59	1.80	59	1.80	59
23, ...	....	150	....	120	3.60	950	2.20	142	2.10	115	1.70	47	1.60	37	1.60	37	1.90	75	3.00	555	1.80	59	1.80	59
24, ...	....	150	....	120	3.20	683	2.10	115	2.00	94	1.60	37	1.60	37	1.80	59	1.90	75	3.10	619	1.80	59	1.80	59
25, ...	....	150	....	120	3.00	555	2.00	94	1.90	75	1.60	37	1.70	47	1.80	59	1.90	75	2.90	491	1.80	59	1.80	59
26, ...	....	150	....	120	2.80	432	2.10	115	1.80	59	1.60	37	1.70	47	2.80	432	1.90	75	2.80	432	1.50	28	1.80	59
27, ...	....	150	....	120	2.80	432	2.00	94	1.80	59	1.60	37	1.70	47	2.20	142	1.80	59	2.20	142	1.50	28	1.90	75
28, ...	....	150	....	120	2.70	375	2.00	94	1.70	47	1.50	28	1.60	37	1.80	59	1.80	59	2.10	115	1.50	28	1.80	59
29, ...	....	150	....	120	5.70	2720	3.30	748	1.70	47	1.50	28	1.50	28	1.80	59	1.80	59	2.10	115	1.50	28	1.80	59
30, ...	....	150	....	......	4.10	1315	2.90	491	1.70	47	1.50	28	1.50	28	1.80	59	1.80	59	2.00	94	1.50	28	1.90	75
31, ...	....	150	....	......	4.10	1315	....	......	1.70	47	....	......	1.50	28	1.80	59	....	......	2.00	94	....	......	3.00	555

On account of ice conditions, the daily discharge from Jan. 5 to March 17, inclusive, estimated from Oil Creek at Rouseville.

ESTIMATED MONTHLY DISCHARGE OF SUGAR CREEK, AT WYATTVILLE, VENANGO COUNTY.

(Drainage area 160 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	190	1.188	1.370
February,	....	....	120	0.750	0.809
March,	....	....	615	3.844	4.432
April,	2000	94	588	3.675	4.100
May,	491	47	189	1.181	1.361
June,	59	28	45	0.281	0.313
July,	47	21	31	0.194	0.224
August,	432	37	58	0.362	0.417
September,	220	47	78	0.488	0.545
October,	619	28	133	0.825	0.951
November,	220	28	86	0.538	0.600
December,	556	47	103	0.644	0.742
The year,	....	....	186	1.164	15.864

Note.—On account of ice conditions the daily discharge from Jan. 5 to March 17, inclusive, estimated from Oil Creek at Rouseville.

CLARION RIVER.

DESCRIPTION OF BASIN.

The Clarion river, one of the largest tributaries of the Allegheny river, draining an area of approximately 1,232 square miles, rises in several branches in the southern part of McKean county. The upper branches flow in a general southerly direction to Johnsonburg, Elk county, where they unite to form the Clarion river proper. From this point the river flows in a general southwesterly direction, in a very tortuous course, to its mouth, at Foxburg, a distance of approximately 95 miles. The elevation of the main stream at Johnsonburg is 1,442 feet, while at its mouth it is 846 feet, giving an average slope of six and one-half feet per mile. From Johnsonburg the river flows through a fairly broad valley until it passes Ridgway, Elk county, where it enters a deep and narrow valley, with high sides, which gradually increase in height as the gorge narrows, so that when the river reaches Clarion county it flows in a narrow bed, with very high precipitous sides, often reaching an altitude of 400 feet above the stream. The hillsides below Ridgway have been practically deforested of their virgin timber and are now covered with a heavy second growth.

The upper portion of the main valley is more thickly inhabited and more largely devoted to agriculture than is the lower section, in which portion the main valley is very sparsely inhabited and largely forest covered, while the plateau land, on either side, is quite generally under cultivation. In the upper portions of the watersheds of the tributaries much of the timber has been destroyed by forest fires and removed by pulp and paper companies, but there are numerous small bituminous coal operations, while in the lower part of the main valley gas wells, in considerable quantities are operated. In Elk county the tributaries are used quite considerably for domestic and industrial water supply, while in Clarion county, with the exception of the borough of Clarion, the stream is little used. In Elk county the stream is badly polluted by tanneries, paper mills and chemical works. The main tributaries are the West Branch, Elk, Little Toby, in Elk county, and Licking, Deer, Piney, Toby and Big Mills creeks, in Clarion county.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since March, 1908, at Clarion, about thirty miles above the mouth.

OHIO BASIN—STATION NO. 11.

CLARION RIVER AT CLARION, PENNA.

DESCRIPTION OF STATION.

This station was established by the United States Weather Bureau, on November 17th, 1884, and is located on the single span, steel, through-truss, highway bridge, about one mile above Clarion, Pa. The gage is maintained and operated by the Weather Bureau, the Water Supply Commission taking the discharge measurements for the rating of the station.

The channel is straight for 800 feet above and 1,200 feet below the station. The banks on either side of the river are high and do not overflow. The bed of the river is permanent, being composed of rock, gravel and boulders. The current is swift.

On November 22nd, 1909, a Mott gage was installed to replace a staff gage. The staff gage, above seven feet, was on an oak plank, while below this point the graduations were painted on a sloping rock. The gage was located near the right abutment and could not be read during extreme low stages. The Mott gage is fastened to the downstream handrail on the bridge and is placed on the same datum as the original staff gage. The elevation of zero of the gage is 1052 feet. Bench Mark No. 1 is top line of right abutment; elevation 1080.48 feeet. The gage is read once daily by J. A. Miller.

On account of the unreliability of the low water readings up to November 22nd, 1909, the Water Supply Commission only publishes the data since that date.

Since the establishment of this station, 21 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CLARION RIVER AT CLARION, CLARION COUNTY, PA.

(Drainage area 910 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
19	March 26	Boehringer and Knight	193	2737	9.81	12.60	26928	Surface msmt.
20	March 26	Boehringer and Knight	198	2826	9.97	13.05	28189	Surface msmt.
21	March 26	Boehringer and Knight	199	2837	10.21	13.11	29250	Surface msmt.

DISCHARGE TABLE FOR CLARION RIVER AT CLARION, CLARION COUNTY, FROM MARCH 20, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
—.60	100	.60	1065	.80	3550	6.00	8020	.20	14300
—.50	110	.70	1135	.90	3710	.10	8260	.30	14620
—.40	120	.80	1210	4.00	3880	.20	8500	.40	14945
—.30	135	.90	1290	.10	4050	.30	8750	.50	15270
—.20	155	2.00	1370	.20	4220	.40	9000	.60	15595
—.10	180	.10	1460	.30	4400	.50	9260	.70	15920
0.00	215	.20	1550	.40	4600	.60	9530	.80	16250
.10	250	.30	1640	.50	4800	.70	9800	.90	16580
.20	285	.40	1740	.60	5000	.80	10080	9.00	16920
.30	325	.50	1840	.70	5200	.90	10370	.10	17260
.40	370	.60	1950	.80	5400	7.00	10660	.20	17600
.50	420	.70	2060	.90	5600	.10	10950	.30	17950
.60	470	.80	2180	5.00	5800	.20	11240	.40	18300
.70	520	.90	2300	.10	6010	.30	11530	.50	18660
.80	570	3.00	2425	.20	6220	.40	11820	.60	19020
.90	620	.10	2550	.30	6440	.50	12120	.70	19380
1.00	675	.20	2680	.40	6660	.60	12420	.80	19750
.10	735	.30	2810	.50	6880	.70	12730	.90	20120
.20	795	.40	2950	.60	7100	.80	13040	10.00	20500
.30	860	.50	3095	.70	7330	.90	13350		
.40	925	.60	3240	.80	7560	8.00	13660		
.50	995	.70	3390	.90	7790	.10	13980		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CLARION RIVER AT CLARION, CLARION COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	....	1100	....	830	......	960	6.60	9530	5.10	6010	1.40	925	0.30	325	0.60	470	2.10	1460	1.40	925	2.35	1690	0.95	648
2, ...	....	1100	....	830	......	960	8.60	15800	4.70	5200	1.20	795	0.30	325	0.50	420	4.60	5000	1.20	795	3.00	2420	1.15	765
3, ...	....	1100	....	830	......	960	11.60	24000	4.20	4220	1.40	925	0.10	250	0.40	370	6.50	9260	1.10	735	2.85	2240	1.75	1170
4, ...	....	1100	....	830	......	960	7.90	13300	4.00	3880	1.30	860	0.10	250	0.40	370	5.60	7100	1.10	735	2.60	1950	2.75	2120
5, ...	....	1100	....	830	......	960	6.70	9800	3.40	2950	1.20	795	0.10	250	0.40	370	4.60	5000	1.00	675	2.15	1500	2.20	1550
6, ...	....	1100	....	830	......	960	5.00	5800	3.20	2680	1.20	795	0.10	250	0.30	325	3.90	3710	1.00	675	1.85	1250	2.65	2000
7, ...	....	1100	....	830	......	960	5.60	7100	3.00	2420	1.10	785	0.00	215	0.30	325	3.20	2680	1.00	675	1.80	1210	4.15	4140
8, ...	....	1100	....	830	......	960	6.60	9530	3.00	2420	1.00	675	0.00	215	0.30	325	2.70	2060	0.90	620	1.55	1030	3.35	2800
9, ...	....	1100	....	830	......	960	5.60	7100	2.90	2300	0.90	620	0.00	215	0.30	325	2.30	1640	0.70	520	2.80	2180	2.95	2360
10, ...	....	1100	....	830	......	960	5.20	6230	2.70	2060	0.90	620	0.00	215	0.40	370	2.00	1870	0.80	570	2.65	2000	2.60	1950
11, ...	....	1100	....	830	......	960	4.60	5000	2.30	1640	0.90	620	0.00	215	0.40	370	1.70	1140	2.10	1460	2.45	1790	2.05	1470
12, ...	....	1100	....	830	......	960	4.00	3880	2.30	1640	0.70	520	0.90	620	0.60	470	1.50	995	2.90	2300	2.35	1640	1.95	1830
13, ...	....	1100	....	830	......	960	3.60	3240	2.50	1840	0.60	470	0.70	520	0.60	470	1.40	925	2.30	1640	1.95	1830	1.95	1830
14, ...	....	1100	....	830	......	960	3.50	3100	2.30	1640	0.60	470	0.80	570	0.50	420	1.20	795	1.30	1210	2.40	1740	1.85	1250
15, ...	....	1100	....	820	......	6600	3.50	3100	3.10	2550	0.60	470	0.50	420	0.50	420	1.10	785	1.70	1140	2.25	1600	1.60	1060
16, ...	....	1100	....	830	*13.00	10000	3.90	3710	3.20	2680	0.80	570	0.50	420	0.40	370	1.10	785	1.50	995	2.05	1420	1.35	892
17, ...	....	1100	....	830	4.60	5000	3.40	2950	3.00	2420	1.00	675	0.50	420	0.40	370	1.50	995	1.30	860	2.00	1370	1.15	765
18, ...	....	1100	....	830	6.00	8020	3.10	2550	3.20	2680	1.40	925	5.50	6830	0.40	370	1.20	795	1.30	860	1.85	1250	1.15	765
19, ...	....	1100	....	830	4.30	4400	2.70	2060	3.50	3100	1.00	675	3.00	2420	0.60	470	1.10	735	1.20	795	1.70	1140	1.65	1100
20, ...	....	1100	....	830	6.00	8020	2.70	2060	3.20	2680	0.90	620	2.60	1950	0.80	570	1.00	675	0.90	620	1.45	960	1.40	925
21, ...	....	1100	....	830	6.60	9530	2.70	2060	3.00	2420	0.90	620	1.20	795	1.00	675	1.00	675	1.00	675	1.35	892	1.15	765
22, ...	....	1100	....	830	5.60	7100	2.70	2060	2.90	2300	0.90	620	2.20	1550	1.00	675	1.00	675	1.00	675	1.20	795	1.15	765
23, ...	....	1100	....	830	5.00	5800	2.70	2060	2.80	2180	0.90	620	1.30	860	1.00	675	1.00	675	1.30	860	1.15	765	1.45	960
24, ...	....	1100	....	830	4.80	5400	2.70	2060	2.70	2060	0.70	520	1.50	995	1.00	675	1.00	675	5.90	7790	1.10	735	2.35	1690
25, ...	....	1100	....	830	4.60	5000	2.30	1640	2.50	1840	0.70	520	1.90	1290	0.90	620	1.60	1060	4.20	4220	0.95	648	2.10	1460
26, ...	....	1100	....	830	4.20	4220	2.30	1640	2.30	1640	0.70	520	1.40	925	1.20	795	2.30	1640	5.10	6010	0.95	648	1.85	1250
27, ...	....	1100	....	830	3.80	3550	2.30	1640	2.10	1460	0.50	420	1.00	675	3.10	2550	1.80	1210	4.10	4050	1.00	675	1.45	960
28, ...	....	1100	....	830	3.60	3240	2.30	1640	2.00	1870	0.50	420	1.00	675	3.00	2420	1.80	1210	3.90	3710	0.95	648	1.25	828
29, ...	....	1100	....	830	5.00	5800	2.60	1950	1.70	1140	0.40	370	1.00	675	2.60	1950	1.50	995	3.40	2950	1.00	675	1.05	705
30, ...	....	1100	....	......	9.00	18200	5.80	7560	1.60	1060	0.30	325	0.80	570	2.30	1640	1.20	795	2.90	2800	0.95	648	2.20	1550
31, ...	....	1100	....	......	8.20	14100	......	......	1.40	925	....	......	0.70	520	2.60	1950	....	......	2.70	2060	....	......	5.65	7220

Note.—River frozen Jan. 1 to March 15, inclusive, daily discharge estimated from Red Bank Creek at St. Charles. *Gorge, discharge estimated.

ESTIMATED MONTHLY DISCHARGE OF CLARION RIVER, AT CLARION, CLARION COUNTY, PA.

(Drainage area 910 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	1100	1.209	1.394
February,	....	....	830	0.912	0.983
March,	....	....	4430	4.868	5.613
April,	24000	1640	5450	5.989	6.682
May,	6010	925	2430	2.670	3.078
June,	925	825	624	0.686	0.766
July,	6880	215	854	0.938	1.082
August,	2550	325	729	0.801	0.923
September,	9260	675	1910	2.099	2.342
October,	7790	520	1750	1.923	2.217
November,	2420	648	1290	1.418	1.582
December,	7220	648	1570	1.725	1.988
The year,	....	....	1910	2.103	28.650

Note.—River frozen Jan. 1 to March 15, inclusive, daily discharge estimated from Red Bank Creek at St. Charles.

RED BANK CREEK.

DESCRIPTION OF BASIN.

Red Bank creek, an important feeder of the Allegheny river from Jefferson, Clarion and Armstrong counties, drains an area of approximately 585 square miles. Rising in two streams, Sandy Lick and North Branch, the former heading in Clearfield county, and the latter in Jefferson county. Red Bank creek is formed by their junction at Brookville, Jefferson county, and thence flows in a general westerly direction, with many twists and turns, to its mouth at Red Bank, a distance of about 44 miles. The stream flows through a hilly country, sparsely populated, except in the valley where farming and lumbering is carried on. The slope of the creek is rapid, flowing as it does in a narrow gorge between high hills, the channel being full of large rocks. The junction lies at an approximate elevation of 1,235 feet, and the mouth at 844 feet, giving the stream an average fall of 9 feet per mile. There are a few boroughs and numerous villages along the stream, some of which obtain their domestic water supply from it. Some bituminous coal mining and oil and gas wells are found in this basin.

The mean annual precipitation over this watershed is from 40 to 50 inches.

The discharge of this stream has been measured at St. Charles since October 19th, 1909, approximately 15 miles above the mouth.

OHIO BASIN—STATION NO. 12.

RED BANK CREEK AT ST. CHARLES, PENNA.

DESCRIPTION OF STATION.

This station was established on October 19th, 1909, by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, and is located on a single span, wooden, through-truss bridge at St. Charles, approximately 15 miles above the mouth.

The channel is straight for a short distance above and below the station. The right bank overflows in extreme high stages, while the left bank is high and not subject to overflow. The bed is composed of large rocks but is fairly regular and permanent. There is no velocity at low stages.

Discharge measurements are taken from the upstream side of the bridge and by wading at lowest stages. The initial point for soundings is top edge of bridge seat, north abutment.

A chain gage is fastened to the bridge floor on the upstream side, fifty feet from the north abutment. The length of chain, from the bottom of the weight to the marker, is 24.54 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is rod seat chiselled in east corner stone, upper course of nose of east abutment (left hand looking downstream) painted white, seven feet more or less below top of bridge seat; elevation 13.32 feet above gage datum. Bench Mark No. 2 is rod seat in southeast corner of top of same abutment (bridge seat), painted white, seven feet more or less above B. M. No. 1; elevation 20.21 feet above gage datum. The gage is read twice daily by W. H. Bish.

Since the establishment of this station, 12 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF RED BANK CREEK AT ST. CHARLES, CLARION COUNTY, PA.

(Drainage area 540 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913							
12	April 2	Boehringer & Knight,	134	484	3.06	3.04	1482	Surface msmt.

DISCHARGE TABLE FOR RED BANK CREEK, AT ST. CHARLES, CLARION COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.60	5	.10	420	.60	1585	.10	4080	.60	6805
.70	10	.20	470	.70	1710	.20	4215	.70	6990
.80	15	.30	520	.80	1840	.30	4400	.80	7175
.90	25	.40	570	.90	1975	.40	4585	.90	7360
1.00	40	.50	630	4.00	2120	.50	4770	7.00	7545
.10	60	.60	700	.10	2275	.60	4955	.10	7730
.20	80	.70	770	.20	2440	.70	5140	.20	7915
.30	110	.80	840	.30	2610	.80	5325	.30	8100
.40	140	.90	910	.40	2780	.90	5510	.40	8285
.50	175	3.00	990	.50	2950	6.00	5695	.50	8470
.60	210	.10	1070	.60	3125	.10	5880	.60	8655
.70	245	.20	1150	.70	3300	.20	6065	.70	8840
.80	285	.30	1240	.80	3475	.30	6250	.80	9025
.90	330	.40	1350	.90	3660	.40	6435	.90	9210
2.00	375	.50	1465	5.00	3845	.50	6620	8.00	9395

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 3 discharge measurements made during 1911-12-13, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF RED BANK CREEK AT ST. CHARLES, CLARION COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.66	1660	......	490	2.80	840	4.85	3570	4.44	2850	1.51	178	0.93	30	1.83	298	3.63	1620	2.10	420	2.63	721	1.63	220
2, ...	3.06	1040	......	490	2.68	756	7.25	8010	3.84	1890	1.49	172	0.90	25	1.70	245	3.03	1010	1.98	366	2.56	672	1.69	242
3, ...	2.86	882	......	490	2.35	545	7.35	8190	3.27	1210	1.41	144	0.98	37	1.50	175	b8.93	e11100	1.88	321	2.43	588	1.63	220
4, ...	2.79	833	......	490	2.03	384	5.70	5140	3.04	1020	1.47	164	1.70	245	1.46	161	6.20	6060	1.70	245	2.23	510	1.53	186
5, ...	2.81	847	......	490	2.02	384	4.68	3260	2.79	833	1.39	137	1.56	196	1.48	163	4.78	3440	1.66	231	2.20	470	1.43	150
6, ...	*	580	......	490	1.25	95	3.95	2050	2.89	908	1.37	131	1.50	175	1.50	175	3.96	2060	1.68	238	2.16	450	4.61	3140
7, ...	....	580	......	490	1.95	352	4.20	2440	3.01	1020	1.29	107	1.40	140	1.46	161	3.36	1310	1.66	231	3.30	1240	2.76	812
8, ...	....	580	......	490	2.35	545	4.10	2280	2.94	942	1.31	113	1.36	128	1.40	140	2.96	958	1.56	196	3.08	1010	2.21	475
9, ...	....	580	......	490	2.95	950	3.75	1780	2.84	868	1.19	78	1.30	110	1.46	161	2.62	721	1.50	175	2.86	882	2.31	525
10, ...	....	580	......	490	2.60	700	3.42	1370	2.57	679	1.27	101	1.16	72	1.33	134	2.46	606	3.06	402	2.73	791	2.56	672
11, ...	....	580	......	490	2.68	756	3.08	1050	2.37	555	1.31	113	1.43	150	1.46	161	2.23	485	2.43	588	2.76	812	2.36	550
12, ...	....	580	......	490	2.48	618	2.95	950	2.14	440	1.31	113	1.60	210	1.38	134	2.06	402	2.83	861	2.58	686	2.06	402
13, ...	....	580	......	490	2.40	570	3.12	1090	2.79	833	1.29	107	1.70	245	2.13	435	1.88	321	2.46	606	2.67	749	1.86	312
14, ...	....	580	......	490	2.30	520	3.02	1010	2.71	777	1.34	122	1.63	220	2.03	388	1.80	285	2.20	470	2.62	714	1.83	298
15, ...	....	580	......	490	6.15	5970	2.78	826	2.57	679	1.29	107	1.56	196	1.78	277	1.83	298	2.06	402	2.54	658	1.86	312
16, ...	....	580	......	490	5.05	3940	2.82	854	2.67	749	2.39	565	1.43	150	1.66	231	2.13	435	1.96	366	2.42	582	2.31	525
17, ...	....	580	......	490	4.85	3570	2.65	735	3.99	2100	2.74	798	1.40	140	1.58	203	1.98	344	1.88	321	2.42	582	2.23	485
18, ...	....	580	......	490	4.45	2860	2.48	618	3.71	1720	2.29	515	a7.78	8990	1.53	186	1.98	336	1.76	269	2.20	470	2.36	550
19, ...	....	580	......	490	4.62	3160	2.38	560	3.44	1400	1.84	303	5.08	3990	1.53	186	2.00	375	1.93	344	2.14	440	2.49	624
20, ...	....	580	......	490	4.75	3390	2.28	510	3.14	1100	1.54	189	2.43	588	1.48	168	1.88	321	1.93	344	2.12	430	2.53	651
21, ...	....	580	......	490	5.15	4120	2.22	480	2.79	833	1.41	144	3.90	1980	1.40	140	1.76	269	1.83	298	2.02	384	2.29	515
22, ...	....	580	......	490	4.62	3160	2.12	430	2.39	565	1.31	113	3.78	1810	2.80	840	1.70	245	1.70	245	1.94	348	2.06	402
23, ...	....	580	......	490	4.52	2980	2.10	420	2.17	455	1.27	101	3.03	1010	2.50	680	1.76	269	1.83	298	1.92	339	1.89	326
24, ...	....	580	......	490	4.82	3510	2.18	460	2.09	416	1.31	113	3.28	1220	2.48	618	1.80	285	4.43	2830	1.84	308	1.83	298
25, ...	....	580	......	490	4.32	2640	2.18	460	2.01	380	1.34	122	3.08	1010	2.40	570	2.10	420	4.68	3260	1.92	339	1.86	312
26, ...	....	580	......	490	4.05	2200	2.12	430	1.94	348	1.17	74	2.73	791	7.50	8470	2.23	485	4.98	3810	1.84	308	1.79	281
27, ...	....	580	†6.11	5900	4.12	2310	1.98	366	1.74	261	1.09	58	2.43	588	7.36	8210	2.06	402	5.23	4270	1.84	308	1.89	326
28, ...	....	580	4.09	2260	4.20	2440	1.90	330	1.77	273	1.11	62	2.86	550	5.83	5380	1.88	321	4.20	2440	1.74	261	1.81	290
29, ...	....	580	3.29	1230	5.78	5290	2.15	445	1.77	273	1.09	58	2.26	500	5.66	5070	2.00	375	3.56	1540	1.54	189	1.79	281
30, ...	....	580	......	......	5.75	5230	5.50	4770	1.71	249	1.01	42	2.10	420	5.28	4360	1.93	344	3.08	1010	1.70	245	2.11	425
31, ...	....	580	......	......	5.10	4060	....	......	1.64	224	....	......	2.00	375	4.78	3440	......	......	2.70	770	....	......	‡4.31	2630

*Creek frozen Jan. 6 to Feb. 26, inclusive, and daily discharge estimated from Allegheny River at Kittanning. †Ice went out. ‡Ice flow running. a Max. 8.68 at 9:00 a. m.; e10600 sec. ft. b Max. 9.88 at 9:00 a. m.; e12800 sec. ft. e Estimated.

ESTIMATED MONTHLY DISCHARGE OF RED BANK CREEK, AT ST. CHARLES, CLARION COUNTY, PA.

(Drainage area 540 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	656	1.215	1.401
February,	5900	....	763	1.413	1.524
March,	5970	95	2220	4.111	4.789
April,	8190	330	1830	3.389	3.781
May,	2850	224	866	1.604	1.849
June,	796	42	171	0.317	0.354
July,	e10600	25	848	1.570	1.810
August,	8470	134	1350	2.500	2.882
September,	e12800	245	1200	2.222	2.479
October,	4270	175	909	1.683	1.940
November,	1240	189	549	1.017	1.135
December,	3140	150	562	1.041	1.200
The year,	....	....	994	1.840	25.094

Note.—e Estimated. Creek frozen Jan. 6-Feb. 26, inclusive; daily discharge estimated from Allegheny River at Kittanning.

MAHONING CREEK.

DESCRIPTION OF BASIN.

Mahoning creek, a tributary of the Allegheny river from Armstrong, Jefferson, Clearfield and Indiana counties, drains an area of approximately 425 square miles. Rising in the southwestern part of Clearfield county, this stream flows in a general westerly direction, with many windings, through a rough, hilly country, to a small extent covered with second-growth timber, to its mouth at Mahoning, on the Allegheny river, a distance of approximately 65 miles. The headwaters of this stream are barren and not farmed to any considerable extent, but numerous bituminous coal mines are located in this region. In the lower region some farming is carried on. The watershed is sparsely inhabited, although a few large boroughs are located in the valley of the stream. The valley is not wide, the stream in general flowing between hills and often rapid in its descent, but at numerous points slow and sluggish. The channel is rocky and usually covered with boulders. The stream is not used for domestic supply, but, to some extent, for industrial purposes.

The mean annual precipitation over this watershed is from 40 to 50 inches.

The discharge has been measured since October 18th, 1909, at Furnace Bridge (Dee) about two and one-half miles above the mouth.

MAHONING CREEK AT FURNACE BRIDGE (DEE), PA.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, on October 18th 1909, and is located on a single span, steel, through truss, highway bridge, about two and one-half miles above the mouth, at the village of Dee.

The channel above and below the station is straight for 800 feet and 150 feet respectively. The right bank is high and not subject to overflow, while the left bank overflows through a very small section during extreme floods. The bed is rocky and permanent.

Discharge measurements are taken from the downstream side of the bridge, and by wading at low stages. The initial point for soundings is top edge of left bridge seat, downstream side.

A standard chain gage is attached to the downstream handrail. The length of chain from bottom of weight to marker is 25.20 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is upstream corner, right abutment, downstream wing, eighth course down from top; elevation 17.43 feet above gage datum. Bench Mark No. 2 is upstream corner of stone on top of B. M. No. 1; elevation 18.54 feet above gage datum. Prior to February 2nd, 1910, readings were taken on a 14-foot staff gage bolted on the upstream wing of the right abutment, but on January 19th, 1910, this gage was carried out by ice, the present chain gage replacing the same and being referred to the same datum. The gage is read once daily by J. D. Bechtel.

Since the establishment of this station, 17 discharge measurements have been made. Owing to the gage heights being unreliable, only discharge measurements and discharge table have been published. The data available prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF MAHONING CREEK, AT FURNACE BRIDGE (DEE), ARMSTRONG COUNTY, PA.

(Drainage area 420 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
17	1913 April 3	Boehringer and Knight	143	471	1.86	3.52	875	Comb. sur. and 0.2 and 0.8 depths.

DISCHARGE TABLE FOR MAHONING CREEK, AT FURNACE BRIDGE, (DEE), ARMSTRONG COUNTY, FROM OCTOBER 18, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.90	6	.90	585	.90	2125	.90	5610	.90	10800
1.00	7	3.00	590	5.00	2240	7.00	5840	9.00	11100
.10	8	.10	650	.10	2360	.10	6070	.10	11400
.20	10	.20	710	.20	2490	.20	6300	.20	11700
.30	15	.30	775	.30	2630	.30	6550	.30	12025
.40	22	.40	840	.40	2780	.40	6800	.40	12350
.50	30	.50	905	.50	2940	.50	7050	.50	12675
.60	40	.60	975	.60	3110	.60	7300	.60	13025
.70	55	.70	1050	.70	3280	.70	7550	.70	13375
.80	75	.80	1125	.80	3450	.80	7800	.80	13750
.90	100	.90	1200	.90	3620	.90	8050	.90	14125
2.00	125	4.00	1280	6.00	3800	8.00	8300	10.00	14500
.10	155	.10	1360	.10	3960	.10	8550	.10	14900
.20	185	.20	1445	.20	4160	.20	8800	.20	15300
.30	225	.30	1530	.30	4370	.30	9050	.30	15725
.40	270	.40	1620	.40	4550	.40	9325	.40	16150
.50	320	.50	1710	.50	4750	.50	9600	.50	16600
.60	370	.60	1800	.60	4950	.60	9900		
.70	425	.70	1900	.70	5170	.70	10200		
.80	480	.80	2010	.80	5390	.80	10500		

Note.—Owing to the gage heights at this station being unreliable, they have not been published and only the discharge measurements and discharge table are furnished herewith.

ALLEGHENY RIVER AT KITTANNING, PENNA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on August 18th, 1904, at the Market Street bridge, in the borough of Kittanning. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania, which has been operating it since that date.

The channel above and below the station is straight for 500 feet and 1,000 feet respectively. Both banks are high and do not overflow. The bed is of gravel and is permanent. The current is swift, and the water at low stages, is approximately three to four feet deep in the first three channels and six to eight feet deep in the last two channels.

Discharge measurements are made from the downstream side of the bridge, which is a five span, steel, through truss, highway bridge. The initial point for soundings is the left end of handrail, downstream side of bridge.

A standard chain gage is bolted to the upstream handrail in the first span from the left bank. The length of chain from bottom of weight to marker is 38.62 feet. Elevation of zero is arbitrary datum. Bench Mark No. 1 is the left corner of top course of stones of left abutment; elevation 33.83 feet above gage datum. The gage is read once daily by Blaine Mast.

Since the establishment of this station, 40 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF ALLEGHENY RIVER, AT KITTANNING, ARMSTRONG COUNTY, PA.

(Drainage area 9,010 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912				Ft.			
40	Dec. 8	Boehringer, ...	842	8345	4.12	9.93	34353	Surface msmt.

DISCHARGE TABLE FOR ALLEGHENY RIVER AT KITTANNING, ARMSTRONG COUNTY, FROM AUGUST 18, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.30	775	.30	10535	.30	33725	.30	63220	.30	99590
.40	880	.40	10980	.40	34400	.40	64040	.40	100600
.50	990	.50	11440	.50	35100	.50	64870	.50	101620
.60	1100	.60	11900	.60	35800	.60	65700	.60	102640
.70	1220	.70	12370	.70	36500	.70	66540	.70	103670
.80	1340	.80	12840	.80	37200	.80	67390	.80	104710
.90	1465	.90	13315	.90	37900	.90	68240	.90	105750
2.00	1605	6.00	13800	10.00	38600	14.00	69100	18.00	106800
.10	1755	.10	14285	.10	39310	.10	69970	.10	107850
.20	1920	.20	14770	.20	40020	.20	70840	.20	108910
.30	2085	.30	15260	.30	40730	.30	71720	.30	109970
.40	2260	.40	15755	.40	41440	.40	72600	.40	111040
.50	2445	.50	16250	.50	42150	.50	73490	.50	112120
.60	2640	.60	16760	.60	42860	.60	74380	.60	113200
.70	2850	.70	17290	.70	43570	.70	75270	.70	114290
.80	3060	.80	17840	.80	44280	.80	76170	.80	115390
.90	3270	.90	18410	.90	44990	.90	77080	.90	116490
3.00	3490	7.00	19000	11.00	45700	15.00	77900	19.00	117600
.10	3715	.10	19590	.10	46420	.10	78800	.10	118710
.20	3940	.20	20190	.20	47140	.20	79700	.20	119820
.30	4165	.30	20790	.30	47860	.30	80600	.30	120930
.40	4390	.40	21400	.40	48590	.40	81500	.40	122050
.50	4620	.50	22025	.50	49320	.50	82410	.50	123170
.60	4850	.60	22650	.60	50050	.60	83320	.60	124290
.70	5080	.70	23275	.70	50780	.70	84230	.70	125410
.80	5335	.80	23900	.80	51520	.80	85150	.80	126540
.90	5580	.90	24525	.90	52260	.90	86070	.90	127670
4.00	5840	8.00	25150	12.00	53000	16.00	87000	20.00	128800
.10	6105	.10	25800	.10	53750	.10	87930	21.00	140200
.20	6380	.20	26450	.20	54510	.20	88870	22.00	152000
.30	6660	.30	27100	.30	55280	.30	89810	23.00	164200
.40	6955	.40	27750	.40	56060	.40	90760	24.00	176800
.50	7260	.50	28400	.50	56840	.50	91720	25.00	189600
.60	7600	.60	29050	.60	57630	.60	92680	26.00	203000
.70	7985	.70	29700	.70	58420	.70	93650	27.00	217000
.80	8375	.80	30350	.80	59210	.80	94630	28.00	231000
.90	8775	.90	31025	.90	60000	.90	95610	29.00	245000
5.00	9200	9.00	31700	13.00	60800	17.00	96600	30.00	259000
.10	9635	.10	32375	.10	61600	.10	97590		
.20	10080	.20	33050	.20	62410	.20	98590		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF ALLEGHENY RIVER AT KITTANNING, ARMSTRONG COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	10.15	39700	......	8100	8.90	31000	15.50	82400	11.60	50000	3.95	5710	2.00	1600	3.10	3720	9.30	33700	5.25	10300	6.55	16500	4.60	7600
2,	9.03	31900	......	8100	8.60	29000	18.50	112000	10.40	41400	3.70	5080	1.90	1460	3.00	3490	11.20	47100	5.10	9640	5.80	12800	6.10	14300
3,	8.05	25500	......	8100	8.10	25800	c23.00	164000	9.30	.33000	3.35	4280	1.90	1460	2.95	3380	e16.20	88900	4.85	8580	5.40	11000	5.80	12800
4,	7.45	21700	......	8100	7.30	20800	17.80	105000	8.00	25200	3.20	3940	1.80	1340	2.80	3060	12.10	53800	4.60	7600	5.15	9860	8.80	30400
5,	6.75	17600	......	8100	6.60	16800	15.10	78800	7.30	20800	3.15	3830	1.85	1400	2.55	2540	9.30	33700	4.40	6960	4.90	8780	9.25	33400
6,	6.20	14800	......	8100	5.80	12800	13.80	67400	6.80	17800	3.40	4390	2.40	2260	2.35	2170	8.20	26400	4.10	6100	4.60	7600	9.10	32400
7,	6.40	15800	......	8100	5.60	11900	13.10	61600	6.60	16800	3.55	4740	2.35	2170	2.20	1920	7.80	23900	3.90	5580	5.80	12800	8.20	26400
8,	*	9900	......	8100	5.70	12400	12.40	56100	6.60	16800	3.50	4620	2.25	2000	2.45	2350	7.30	20800	3.70	5080	6.60	16800	9.93	38100
9,	......	9900	......	8100	5.90	13300	12.30	55300	6.40	15800	3.20	3940	2.10	1760	2.60	2640	7.05	19300	3.45	4500	7.90	24500	7.40	21400
10,	......	9900	......	8100	5.90	13300	11.60	50000	6.40	15800	2.95	3380	2.00	1600	2.80	3060	6.40	15800	3.20	3940	8.60	29000	7.30	20800
11,	......	9900	......	8100	5.70	12400	11.05	46100	6.20	14800	2.80	3060	2.05	1680	3.20	3940	5.90	13300	3.30	4160	8.90	31000	6.90	18400
12,	......	9900	......	8100	5.50	11400	10.60	42900	6.10	14300	2.65	2740	2.40	2260	3.30	4160	5.30	10500	3.90	5580	8.00	25200	6.40	15800
13,	......	9900	......	8100	5.40	11000	10.40	41400	6.20	.14800	2.50	2440	3.30	4160	3.25	4050	4.60	7600	4.30	6660	7.30	20800	5.95	13600
14,	......	9900	......	8100	7.20	20200	9.70	36500	6.30	15300	2.45	2350	3.10	3720	3.10	3720	4.10	6100	4.20	6380	6.50	16200	5.60	11900
15,	......	9900	......	8100	9.05	32000	8.95	31400	6.90	18400	2.60	2640	2.80	3060	2.90	3270	3.90	5580	4.05	5970	6.10	14300	5.25	10300
16,	......	9900	......	8100	9.50	35100	9.30	33700	7.40	21400	4.20	6380	2.70	2850	2.70	2850	4.20	6380	3.90	5580	6.90	18400	5.05	9420
17,	......	9900	......	8100	16.40	90600	9.30	33700	7.80	23900	3.80	5340	3.15	3830	2.55	2540	4.00	5840	4.20	6380	6.40	15800	5.40	11000
18,	......	9900	......	8100	13.70	66500	9.05	32000	8.30	27100	3.65	4960	d8.30	27100	2.40	2260	4.60	7600	4.60	7600	5.70	12400	5.80	12800
19,	......	9900	......	8100	14.10	70000	8.50	28400	8.10	25800	3.40	4390	5.55	11700	2.45	2350	4.35	6810	4.25	6520	5.20	10100	5.60	11900
20,	......	9900	......	8100	15.50	82400	7.75	23600	7.85	24200	3.20	3940	5.10	9640	3.80	5340	4.20	6380	4.10	6100	4.90	8780	5.25	10300
21,	......	9900	......	8100	17.20	98600	7.20	20200	7.60	22600	2.95	3380	5.30	10500	3.65	4960	4.10	6100	4.80	8380	4.70	7980	4.85	8580
22,	......	9900	......	8100	14.90	77100	6.90	18400	7.20	20200	2.80	3060	6.50	16200	3.60	4850	3.95	5710	5.40	11000	4.45	7110	4.50	7260
23.	......	9900	......	8100	12.60	57600	6.60	16800	6.75	17600	2.60	2640	6.10	14300	3.20	3940	3.85	5460	6.30	15300	4.20	6380	4.30	6660
24,	......	9900	......	8100	12.10	53800	6.40	15800	6.20	14800	2.90	3270	5.40	11000	2.85	3160	4.30	6660	8.10	25800	3.95	5710	†4.20	6380
25,	......	9900	......	8100	11.80	51500	6.10	14300	5.70	12400	2.85	3160	4.90	8780	2.40	2260	6.70	17300	12.10	53800	3.80	5340	†4.05	5970
26,	......	9900	......	8100	10.05	39000	5.90	13300	5.25	10300	2.60	2640	4.65	5970	6.90	18400	6.50	16200	13.60	65700	3.70	5080	3.90	5580
27,	......	9900	a13.25	62800	9.55	35400	5.80	12800	4.80	8380	2.40	2260	3.70	5080	10.40	41400	5.60	11900	12.05	.58100	3.55	4740	3.80	5340
28,	......	9900	9.90	37900	9.10	32400	5.70	12400	4.40	6960	2.25	2000	3.45	4500	8.20	26400	4.95	8990	10.20	40000	3.45	4500	4.00	5840
29,	......	9900	9.30	33700	11.30	47900	6.00	13800	4.00	5840	2.15	1840	3.20	3940	7.40	21400	4.80	8380	9.00	31700	3.30	4160	4.30	6660
30,	......	9900	......	......	b17.85	100000	10.75	43900	3.90	5580	2.10	1760	3.05	3600	8.40	27800	4.65	7790	8.10	25800	3.20	3940	5.40	11000
31,	......	9900	......	......	17.50	102000	......	....	4.05	5970	....	....	2.95	3380	8.70	29700	......	......	7.40	21400	....	......	9.60	35800

*River frozen Jan. 8 to Feb. 26, inclusive, and discharge estimated from W. Br. Susquehanna River at Williamsport, Black Lick Cr., Brokenstraw Cr., and climatological records. Ice broke Feb. 27, at 3:30 a. m. a Max. 15.70′ at 6:00 a. m.; 84200 sec ft. b Max. 17.90′ at 5 p. m.; 106000 sec. ft. c Max. 23.40′ at 9 a. m.; 169000 sec. ft. d Max. 9.20′ at 11:00 a. m.;=33000 sec. ft. e Max. 16.90′ at 10:30 a. m.; 95600 sec ft. †Floating ice.

ESTIMATED MONTHLY DISCHARGE OF ALLEGHENY RIVER, AT KITTANNING, ARMSTRONG COUNTY.

(Drainage area 9,010 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	39700	....	13100	1.454	1.676
February,	84200	....	11900	1.321	1.425
March,	106000	11000	42394	4.705	5.424
April,	169000	12400	45467	5.046	5.630
May,	50000	5580	18840	2.091	2.411
June,	6380	1760	3605	0.400	0.446
July,	33000	1340	5623	0.624	0.719
August,	41400	1920	7970	0.885	1.020
September,	95600	5460	17799	1.975	2.204
October,	65700	3940	15532	1.724	1.987
November,	31000	3940	12585	1.397	1.559
December,	38100	5340	15100	1.676	1.982
The year,	169000	....	17400	1.942	26.483

Note.—River frozen Jan. 8 to Feb. 26, inclusive, and discharge estimated from West Br. Susquehanna River at Williamsport, Blacklick Creek, Brokenstraw Creek and climatological records.

CROOKED CREEK.

DESCRIPTION OF BASIN.

Crooked creek, a tributary of the Allegheny river in Armstrong county, drains approximately 290 square miles. Rising in numerous branches in the west central part of Indiana county, it follows first a general southwesterly course through a coal mining and farming region to the Indiana-Armstrong county line, and then turns northwest through a sparsely settled farming region to its mouth at Rosstown, a total distance of approximately 54 miles.

This basin is largely deforested, and in some sections the hillsides are bare. The elevation of the source of Crooked creek is about 1,400 feet, and of the mouth 786 feet. Near the headwaters the slope is steep, averaging in seven and one-half miles about 40 feet per mile, while below this point to its mouth, a distance of approximately 46 miles, the rate of fall is very uniform, being at the rate of 7 feet per mile. The principal tributaries are Plum and Cherry creeks. This creek flows in a broad valley, which lies about 300 to 400 feet below the elevation of the adjacent hills, the bottom is stony and the stream tortuous in its course.

Numerous farming and coal mining villages lie in this drainage area, and some of these obtain water supplies from the stream or its tributaries. The stream proper is badly polluted by effluents from coal washing at the mines.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since October 16, 1909, at Hileman's Farm, approximately 3 miles above the mouth.

OHIO BASIN—STATION NO. 15.

CROOKED CREEK AT HILEMAN'S FARM, ARMSTRONG CO., PENNA.

DESCRIPTION OF STATION.

This station was established on October 16, 1909, by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, and is located about 3 miles above the mouth, and about 3½ miles from Ford City, on a single span, steel, through truss, highway bridge.

The channel is straight for 800 feet above, and 500 feet below the station. Both banks are high and do not overflow. The bed of the stream is rocky, the water deep, and velocity is slight at low stages.

Discharge measurements are taken from the downstream side of the bridge during medium and high stages, and by wading at low stages. The initial point for soundings is top edge of bridge seat, right abutment.

On October 16, 1909, a staff gage was bolted to the upstream face of the right abutment, but on January 16, 1910, this gage was carried away by the ice. On February 3, 1910, a standard chain gage was placed on the upstream handrail near the right bank. Length of chain from bottom of weight to marker is 22.70 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is on top of stone in upstream face or wing of right abutment, 2 inches from right end of stone; stone is 7th course down from bridge seat, and 8th stone in from face, 6 feet more or less from top of wall; elevation 12.95 feet above gage datum. The gage is read twice daily by J. T. Hileman.

Since the establishment of this station, 13 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CROOKED CREEK, AT HILEMAN'S FARM, ARMSTRONG COUNTY, PA.

(Drainage area 279 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
13	1913 April 3	Boehringer & Reckord	134	378	0.95	2.37	360	0.2 and 0.8 msmt.

DISCHARGE TABLE FOR CROOKED CREEK, AT HILEMAN'S FARM, ARMSTRONG COUNTY, FROM OCTOBER 16, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.50	2	.60	359	.70	2180	.80	4770	.90	8700
.60	2	.70	403	.80	2300	.90	4920	9.00	8900
.70	2	.80	451	.90	2420	7.00	5070	.10	9100
.80	3	.90	500	5.00	2530	.10	5230	.20	9300
.90	5	3.00	555	.10	2640	.20	5390	.30	9500
1.00	7	.10	620	.20	2750	.30	5560	.40	9700
.10	11	.20	690	.30	2860	.40	5730	.50	9900
.20	18	.30	770	.40	2980	.50	5910	.60	10100
.30	26	.40	850	.50	3090	.60	6100	.70	10300
.40	36	.50	940	.60	3200	.70	6300	.80	10500
.50	48	.60	1030	.70	3320	.80	6500	.90	10700
.60	61	.70	1120	.80	3440	.90	6700	10.00	10900
.70	77	.80	1220	.90	3560	8.00	6900	.10	11100
.80	97	.90	1320	6.00	3680	.10	7100	.20	11300
.90	120	4.00	1420	.10	3810	.20	7300	.30	11500
2.00	145	.10	1520	.20	3940	.30	7500	.40	11700
.10	174	.20	1630	.30	4070	.40	7700	.50	11900
.20	205	.30	1740	.40	4200	.50	7900	.60	12100
.30	240	.40	1850	.50	4340	.60	8100		
.40	278	.50	1960	.60	4480	.70	8300		
.50	318	.60	2070	.70	4620	.80	8500		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CROOKED CREEK AT HILEMAN'S FARM, ARMSTRONG COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.04	581	1.74	85	....	300	3.79	1210	4.09	1510	1.64	67	1.49	47	3.15	655	3.45	895	1.65	69	2.15	190	1.70	77
2, ...	2.74	422	1.59	60	....	300	4.74	2230	3.54	976	1.64	67	1.59	60	2.85	476	7.10	5230	1.55	54	2.75	427	2.20	205
3, ...	2.79	446	1.74	85	....	300	5.24	2790	2.99	570	1.49	47	1.69	75	3.15	655	8.80	8500	1.60	61	1.85	108	1.95	132
4, ...	3.09	614	1.74	85	....	300	4.29	1730	2.24	219	1.44	41	1.59	60	3.00	555	6.05	3740	1.60	61	1.75	87	1.75	87
5, ...	2.79	446	1.74	85	....	300	3.19	683	1.99	142	1.49	47	1.49	47	2.75	427	5.05	2580	1.75	87	1.65	69	1.75	87
6, ...	2.79	446	1.69	75	....	300	2.69	399	2.09	171	1.44	41	1.59	60	2.25	222	4.65	2120	1.55	54	1.75	87	4.00	1420
7, ...	2.49	314	1.64	67	....	300	3.94	1360	2.14	186	1.34	30	1.64	67	2.85	476	3.95	1370	1.70	77	2.75	427	5.80	3440
8, ...	2.54	334	1.59	60	....	300	3.19	683	1.79	95	1.19	17	1.49	47	3.25	730	2.95	528	1.60	61	3.40	850	4.35	1800
9, ...	2.39	274	1.49	47	....	300	3.24	722	1.69	75	1.19	17	1.39	35	3.40	850	2.60	359	1.70	77	3.40	850	3.80	1220
10, ...	2.44	294	1.39	35	....	300	3.04	581	1.84	106	1.19	17	1.19	17	2.75	427	2.35	259	1.85	108	2.15	190	3.65	1080
11, ...	2.34	255	1.44	41	....	300	2.79	446	1.79	95	1.19	17	1.19	17	2.95	528	2.20	205	1.70	77	2.10	174	3.05	588
12, ...	2.29	236	1.39	35	....	300	2.44	294	1.84	106	1.24	21	1.09	11	3.25	730	2.05	160	1.70	77	2.05	160	2.60	359
13, ...	2.24	219	1.34	30	....	300	2.69	399	2.19	202	1.29	25	1.14	14	3.15	655	2.15	190	1.65	69	2.25	222	2.70	408
14, ...	2.09	171	1.34	30	b	300	2.29	236	2.14	186	1.09	11	1.19	17	3.00	555	2.30	240	1.65	69	2.10	174	2.60	359
15, ...	1.99	142	1.44	41	5.49	3080	2.14	186	2.19	202	1.74	85	1.19	17	2.75	427	2.20	205	1.60	61	1.80	97	2.40	278
16, ...	2.04	157	1.44	41	3.19	683	2.09	171	2.29	236	3.39	842	1.29	25	2.63	372	2.20	205	1.50	48	1.95	132	2.15	190
17, ...	2.14	186	1.49	47	3.74	1160	2.29	236	2.64	377	c6.74	4680	1.29	25	2.48	310	2.15	190	1.60	61	1.80	97	2.05	160
18, ...	2.24	219	....	45	3.24	722	2.29	236	3.64	1070	6.74	4680	3.39	842	2.33	251	2.25	222	1.75	87	1.65	69	1.85	108
19, ...	2.49	314	....	45	2.79	446	2.09	171	3.39	842	5.04	2570	3.14	618	2.53	330	2.10	174	2.45	298	1.65	69	1.75	87
20, ...	a6.54	4400	....	300	2.34	255	1.99	142	2.94	522	3.29	762	2.94	522	2.48	310	2.10	174	2.70	408	1.80	97	1.85	108
21, ...	3.34	802	....	300	7.89	6680	2.09	171	2.44	294	2.79	446	4.04	1460	2.28	233	2.10	174	2.60	359	1.65	69	1.90	120
22, ...	2.74	422	....	300	5.29	2850	1.99	142	2.09	171	2.64	377	6.79	4760	2.33	251	1.90	120	3.15	655	1.75	87	1.85	108
23, ...	2.49	314	....	300	3.59	1020	2.04	157	1.94	130	2.19	202	3.59	1020	2.53	330	1.80	97	3.95	1370	1.65	69	1.75	87
24, ...	2.44	294	....	300	3.89	1310	2.09	171	1.79	95	2.04	157	3.59	1020	2.48	310	1.75	87	5.70	3320	1.50	48	*1.75	87
25, ...	2.34	255	....	300	4.14	1560	2.19	202	1.74	85	2.04	157	3.84	1260	2.48	310	1.80	97	6.55	4410	1.55	54	*1.75	87
26, ...	2.29	236	....	300	3.84	1260	2.04	157	1.69	75	1.84	106	2.94	522	4.63	2100	2.00	145	5.55	3140	1.40	36	†1.80	97
27, ...	2.24	219	....	2500	4.24	1670	1.99	142	1.59	60	1.69	75	2.54	334	6.08	3720	1.95	132	4.45	1900	1.35	31	1.85	108
28, ...	2.14	186	....	1000	4.54	2000	2.09	171	1.44	41	1.59	60	2.69	399	4.43	1380	1.75	87	3.40	850	1.30	26	1.85	108
29, ...	2.09	171	....	400	5.94	3610	2.99	550	1.74	85	1.49	47	3.19	683	3.88	1300	1.70	77	2.90	500	1.50	48	1.95	132
30, ...	2.04	157	....	......	5.94	3610	4.94	2460	1.94	130	1.59	60	2.64	377	3.23	714	1.65	69	2.45	298	1.45	42	‡5.85	3500
31, ...	1.84	106	....	......	3.99	1410	....	......	1.89	118	......	......	2.24	219	3.98	1400	....	......	2.10	174	....	......	4.40	1850

a Max. 8.64 at 7:30 a. m.; 8180 sec. ft. b Ice jam at mouth. c Max. 8.14 at 5:00 p. m.; 7180 sec. ft. *Ice at gage. †Creek frozen. ‡Ice went out. On account of ice conditions, daily discharge estimated from Feb. 18 to March 14, inclusive, from climatological records.

ESTIMATED MONTHLY DISCHARGE OF CROOKED CREEK, AT HILEMAN'S FARM, ARMSTRONG COUNTY, PA.

(Drainage area 279 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	8180	106	440	1.577	1.818
February,	....	....	243	0.871	0.969
March,	....	....	1210	4.337	5.000
April,	2790	142	641	2.297	2.563
May,	1510	41	295	1.057	1.219
June,	7180	11	526	1.885	2.104
July,	4760	11	474	1.699	1.959
August,	3720	222	725	2.599	2.997
September,	8500	69	954	3.419	3.815
October,	4410	48	611	2.190	2.525
November,	850	26	170	0.609	0.680
December,	3500	77	596	2.136	2.463
The year,	....	....	574	2.056	28.082

Note.—On account of ice conditions the daily discharge from Feb. 18 to March 14, inclusive, was estimated from climatological records.

BLACK LICK CREEK.

DESCRIPTION OF BASIN.

Black Lick creek, one of the largest of the tributaries of the Conemaugh river, is formed by the junction of the North and South Branches on the line between Indiana and Cambria counties at Vintondale. It thence flows westerly through the southern part of Indiana county for about 26 miles to its mouth near Blairsville. The total drainage area tributary above its mouth is 412 square miles. The North Branch rises in the southwestern part of Carroll township, at an elevation of 2,000 feet, and is 16 miles long, draining 70 square miles, and the latter rises in the northern part of Cambria township and is approximately the same length, draining 48 square miles.

In its extreme upper portion the North Branch flows through a steep mountainous country, while the lower portion contains more cleared land, is more inhabited and the hills are lower and less steep. The watershed of the South Branch is similar but is more inhabited and includes considerable bituminous coal, which is being actively mined.

The valley of the main creek is rather broad, with numerous wide flat areas, similar to the one at its junction with its chief tributary, Two Lick creek, at Josephine. The rounded hills, which rise some 400 or 500 feet on either side are often wooded.

Below the forks of the North and South Branches and extending to its mouth and up Two Lick creek, is an extensive bituminous coal field. The main valleys are largely under cultivation, but numerous tributaries drain areas densely covered with second growth.

The slope between the forks and mouth is 18.3 feet per mile, quite sluggish at some points and exceedingly rapid at others.

The North and South Branches and Two Lick creek are all used for domestic and industrial supply, as well as certain other tributaries, while the use of water from the main stream and the tributary by coal mines, steel works, etc. is extensive.

The mean annual precipitation over this watershed is from 40 to 50 inches.

The discharge has been measured since August 16th, 1904, at Black Lick, just below the mouth of Two Lick creek.

OHIO BASIN—STATION NO. 16.

BLACK LICK CREEK AT BLACK LICK, PENNA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on August 16th, 1904. On July 15th, 1906, it was discontinued by the Survey and on January 8th, 1907, it was re-established by the Water Supply Commission of Pennsylvania, which has been operating the station since that date. It was originally located at a covered wooden highway bridge one-quarter of a mile from the railroad station at Black Lick, but during September, 1905, this bridge was torn down and was replaced by a three-span, steel, through truss, highway bridge.

The channel above the station is straight for 2,000 feet, while below it is straight for 250 feet, to an island, at which point it bends to the right. The right bank is high and not subject to overflow, while the left bank overflows above gage height 11.5 feet. The bed is of gravel, sand and boulders and is permanent.

Discharge measurements are made from the upstream side of the bridge at ordinary stages; from a coal tipple one-quarter mile above the bridge at high stages; and by wading above the bridge at extreme low stages. Initial point for soundings at the highway bridge is the first angle post in upstream handrail at left bank.

A standard chain gage was established November 9th, 1905, on the present bridge, being referred to the same datum as the former gage on the covered bridge. While the steel bridge was under construction, the stage of the creek was observed on a staff gage, to the same datum as the original gage. The present gage is bolted to the upstream side of the bridge. The length of the chain from the bottom of the weight to the marker is 20.16 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is nail in first maple tree from door of Maynard's house, one foot above the ground, driven horizontally, and bent over one inch from the head; elevation 13.92 feet above gage datum. Bench Mark No. 2 is head of four spikes driven into the root of a large maple 45 feet from edge of low water and about 190 feet upstream from bridge; elevation 12.96 feet above gage datum. Bench Mark No. 3 is upper edge of horizontal cross plate at elevation of guard rail on upstream side of bridge, 4.3 feet from initial point for soundings elevation 14.43 feet above gage datum. The gage is read twice daily by D. J. Walling.

Two Lick Creek enters the stream about three-fourths of a mile above the bridge. Two miles upstream is a ten-foot wooden dam used by the Josephine Furnace and Coke Company for generating electricity for their plant.

Since the establishment of this station 26 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF BLACK LICK CREEK, AT BLACK LICK, INDIANA COUNTY, PENNA.

(Drainage area 386 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
22	Dec. 6	Boehringer, ...	208	985	2.41	5.80	2372	Surface msmt.
	1913							
23	Jan. 9	Reckord, ...	208	1346	4.04	7.01	5442	Surface msmt.
24	Jan. 9	Reckord, ...	208	1294	3.85	6.72	4976	Surface msmt.
25	Jan. 9	Reckord, ...	208	1211	3.51	6.89	4255	Surface msmt.
26	Jan. 12	Reckord, ...	209	1685	5.43	8.60	9153	Surface msmt.

DISCHARGE TABLE FOR BLACK LICK CREEK, AT BLACK LICK, INDIANA COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.90	8	.20	1140	.50	4455	.80	9320	.10	15210
2.00	21	.30	1230	.60	4655	.90	9540	.20	15500
.10	38	.40	1320	.70	4855	9.00	9760	.30	15795
.20	59	.50	1420	.80	5060	.10	9990	.40	16090
.30	83	.60	1520	.90	5270	.20	10220	.50	16390
.40	110	.70	1620	7.00	5480	.30	10460	.60	16690
.50	140	.80	1730	.10	5690	.40	10700	.70	16995
.60	172	.90	1845	.20	5900	.50	10950	.80	17300
.70	205	5.00	1960	.30	6110	.60	11200	.90	17610
.80	240	.10	2090	.40	6320	.70	11450	12.00	17920
.90	280	.20	2230	.50	6530	.80	11700	.10	18235
3.00	320	.30	2375	.60	6740	.90	11950	.20	18550
.10	365	.40	2525	.70	6950	10.00	12200	.30	18895
.20	415	.50	2680	.80	7160	.10	12460	.40	19240
.30	470	.60	2840	.90	7370	.20	12720	.50	19585
.40	525	.70	3000	8.00	7580	.30	12985	.60	19930
.50	590	.80	3165	.10	7790	.40	13250	.70	20285
.60	660	.90	3335	.20	8000	.50	13525	.80	20640
.70	730	6.00	3510	.30	8220	.60	13800	.90	21020
.80	805	.10	3690	.40	8440	.70	14080	13.00	21400
.90	885	.20	3875	.50	8660	.80	14360		
4.00	965	.30	4060	.60	8880	.90	14640		
.10	1050	.40	4255	.70	9100	11.00	14920		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 5 discharge msmts. made during 1912 and 1913, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF BLACK LICK CREEK, AT BLACK LICK, INDIANA COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	4.97	1930	3.01	324	3.97	941	4.68	1600	4.88	1820	2.67	195	2.52	146	3.44	551	3.45	558	3.48	577	3.48	577	2.68	198
2, ...	4.29	1220	2.99	316	3.64	688	5.49	2660	4.42	1340	2.62	179	2.46	128	3.24	437	8.17	7940	3.26	448	3.44	551	2.82	248
3, ...	4.07	1020	2.98	312	3.36	508	5.80	3160	4.05	1010	2.67	195	2.48	134	3.50	590	g11.86	17500	3.16	395	3.28	459	3.53	611
4, ...	3.73	752	2.82	248	3.32	481	4.78	1710	3.82	821	2.61	175	2.46	128	3.22	426	7.98	7540	3.06	347	3.14	385	3.18	405
5, ...	3.28	459	2.76	226	3.26	448	4.44	1360	3.58	646	2.56	159	2.60	172	2.98	312	5.49	2660	2.96	304	3.04	338	3.04	338
6, ...	*3.29	464	2.74	219	3.16	395	4.14	1090	3.54	618	2.55	156	2.62	179	2.86	264	4.65	1570	2.87	268	2.98	312	4.98	1940
7, ...	3.29	464	2.72	212	3.13	380	4.08	1030	3.60	660	2.55	156	2.57	162	2.78	233	4.20	1140	2.78	233	3.58	646	4.88	1820
8, ...	3.37	508	2.70	205	3.42	538	4.33	1260	4.10	1050	2.48	134	2.40	110	2.72	212	3.96	983	2.69	202	4.14	1090	4.11	1060
9, ...	3.39	520	2.98	312	4.38	1300	3.92	901	3.94	917	2.40	110	2.31	86	2.68	196	3.56	632	3.16	395	3.69	728	3.72	745
10, ...	3.44	551	2.84	256	3.80	805	3.72	745	3.71	738	2.33	91	2.52	146	2.84	256	3.32	481	3.24	437	3.60	660	3.44	551
11, ...	3.31	476	*2.77	230	3.55	625	3.58	646	3.46	564	2.26	73	2.76	226	2.98	312	3.16	395	2.92	288	3.53	611	3.68	716
12, ...	3.23	432	2.62	179	3.62	674	3.48	577	3.42	538	2.22	64	2.60	172	3.63	681	3.06	347	2.80	240	3.46	564	3.83	829
13, ...	3.09	360	2.66	192	4.56	1480	3.94	917	3.76	775	2.22	64	2.50	140	3.48	577	2.96	304	2.74	219	3.41	532	*3.78	790
14, ...	3.16	395	2.56	159	3.95	925	3.74	760	3.61	667	2.20	59	2.44	122	3.37	508	2.88	272	2.72	212	3.40	525	3.51	597
15, ...	3.01	324	2.50	140	7.89	7850	3.60	660	3.38	514	2.56	159	2.90	280	3.28	459	2.86	264	2.70	205	3.31	476	3.16	395
16, ...	2.97	308	2.43	119	6.91	5290	3.64	688	d5.84	3230	e8.10	7790	2.86	264	3.09	360	3.11	370	2.62	179	3.20	415	3.14	385
17, ...	2.97	308	2.44	122	5.44	2590	3.61	667	6.04	3580	6.46	4380	3.53	611	2.88	272	2.99	316	2.60	172	3.10	365	3.10	365
18, ...	3.03	334	2.46	128	5.48	2650	c5.99	3490	5.08	2060	4.70	1620	5.70	3000	2.80	240	2.87	268	2.58	166	3.04	338	3.16	395
19, ...	†4.47	1390	2.72	212	5.40	2520	4.74	1660	4.46	1380	3.97	941	4.82	1250	2.82	248	3.18	405	2.82	248	3.00	320	3.28	459
20, ...	4.53	1450	†4.42	1340	5.62	2870	4.39	1310	4.12	1070	3.58	646	3.58	646	4.01	974	3.08	356	3.08	356	2.98	312	3.16	395
21, ...	4.13	1080	4.56	1480	b10.20	12700	4.06	1020	3.76	775	3.39	520	f6.00	3510	3.90	885	2.80	240	2.84	256	2.94	296	3.18	405
22, ...	3.77	782	4.98	1940	7.36	6240	3.76	775	3.52	604	3.38	514	6.38	4220	3.84	837	2.70	205	2.72	212	2.88	272	3.19	410
23, ...	3.79	798	4.18	1120	5.48	2650	3.88	869	3.32	481	3.20	415	4.62	1540	3.83	829	3.10	365	5.89	3320	2.83	252	3.08	356
24, ...	4.05	1010	3.82	821	6.39	4240	3.70	730	3.17	400	3.25	442	4.80	1730	3.64	688	4.28	1210	5.31	2390	2.80	240	2.92	288
25, ...	3.84	837	3.80	805	6.16	3800	3.55	625	3.06	347	3.11	370	4.78	1710	3.30	470	4.00	965	h6.60	4660	2.82	248	‡2.86	264
26, ...	3.55	625	6.69	4840	5.14	2150	3.54	618	2.92	288	2.88	272	4.02	982	3.20	415	3.66	702	6.20	3880	2.79	236	2.80	240
27, ...	3.35	498	a8.40	8440	4.71	1680	3.59	653	2.82	248	2.82	248	3.68	716	3.88	869	4.38	1300	5.04	2010	2.76	226	2.92	288
28, ...	3.18	405	5.58	2810	5.40	2520	3.48	577	2.78	233	2.66	192	3.38	514	3.49	584	3.78	790	4.45	1370	2.73	216	2.91	284
29, ...	3.18	405	4.54	1460	6.98	5440	3.91	893	2.81	244	2.62	179	3.50	590	3.42	538	3.66	702	4.06	1020	2.66	192	2.75	222
30, ...	3.25	442	......	......	5.74	3070	5.62	2870	2.98	292	2.58	166	3.40	525	3.32	481	3.72	745	3.78	790	2.66	192	3.76	775
31, ...	3.13	380	......	......	5.16	2170	......	......	2.82	248	......	......	3.14	385	3.29	464	......	......	3.56	682	....	......	5.38	2500

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*Creek frozen across. †Ice going out. ‡Ice all out of creek. On Feb. 20th ice gorge formed ½ mile above gaging station 15 ft. high, went out Feb. 26th. a Max. 9.60′ at 7 a. m.; 11200 sec. ft. b Max. 11.10′ at 1 p. m.; 15200 sec. ft. c Max. 6.42′ at 1 p. m.; 4300 sec. ft. d Max. 7.36′ at 6 p. m.; 6240 sec. ft. e Max. 9.60′ at 2 p. m.; 11200 sec. ft. f Max. 7.90′ at 7 p. m.; 7370 sec. ft. g Max. 12.90′ at noon; 21000 sec. ft. h Max. 7.10′ at 6 p. m.; 5690 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF BLACK LICK CREEK, AT BLACK LICK, INDIANA COUNTY, PA.

(Drainage area 386 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	1930	308	675	1.749	2.017
February,	11200	119	1006	2.606	2.811
March,	15200	880	2583	6.692	7.715
April,	4300	577	1217	3.153	3.518
May,	6240	233	908	2.352	2.711
June,	11200	59	689	1.785	1.992
July,	7370	88	791	2.049	2.362
August,	974	198	489	1.267	1.461
September,	21000	205	1716	4.446	4.961
October,	5690	166	853	2.210	2.548
November,	1090	192	419	1.085	1.210
December,	2500	198	622	1.611	1.857
The year,	21000	59	997	2.584	35.163

LOYALHANNA CREEK.

DESCRIPTION OF BASIN.

Loyalhanna creek, an important tributary of the Kiskiminetas river, draining an area of approximately 300 square miles, rises in the southern part of Westmoreland county, Pa., and flows in a northerly direction, for a distance of about 45 miles, to its mouth, at the junction of the Conemaugh and Kiskiminetas rivers. In the upper watershed it flows through a narrow valley between Chestnut and Laurel Ridges, the course being very circuitous, for a distance of about 15 miles, at which point it breaks through Chestnut Ridge into a succession of wide, flat, bottom lands, well populated by a coal mining and agricultural community, the hills becoming low and rolling. The fall of the creek, from the foot of Chestnut Ridge to its mouth, a distance of approximately 27 miles, is rather uniform at the rate of about six feet per mile. In the gap through Chestnut Ridge the creek falls 100 feet in a distance of four miles, or at the rate of 25 feet per mile. There are numerous large tributaries at the headwaters of this stream, but in its lower reaches they become much smaller and are of little importance. The stream is polluted by mine waste from Chestnut Ridge to its mouth. There are numerous towns in this watershed, the largest of which are Latrobe and Ligonier.

Loyalhanna creek and several of its tributaries are used for commercial and industrial water supply purposes.

The mean annual precipitation over the upper watershed is from 45 to 50 inches, while the lower portion is from 35 to 45 inches.

OHIO BASIN—STATION NO. 17.

LOYALHANNA CREEK NEAR NEW ALEXANDRIA.

DESCRIPTION OF STATION.

This station was established on October 7th, 1910, by the Flood Commission of Pittsburgh, and is located on the single span, steel, through-truss, highway bridge about one and one-half miles below New Alexandria, Westmoreland County, Pa. On February 1st, 1912, the station was discontinued, but again re-established on April 24th, 1912, by the Water Supply Commission of Pennsylvania. During the period June 18th to July 31st, inclusive, no readings were taken due to repairs being made to the bridge upon which the gage is located.

The channel is straight for one hundred feet above and one thousand feet below the station. The right bank is high and does not overflow, while the left bank overflows during extreme high stages. The bed is gravelly and is permanent.

Discharge measurements are taken from the downstream side of the bridge and by wading either above or below the station during low water. The initial point for soundings is top edge of left abutment, 1.8 feet from end of handrail, downstream side of bridge.

A chain gage is fastened to the floor of the bridge, eighty-seven feet from the initial point for soundings, downstream side. The length of the chain from the bottom of the weight to the center of the marker is 24.11 feet. The elevation of zero is 909.34 feet. Bench Mark No. 1 is bridge seat, west side, north abutment; elevation 932.89 feet or 23.55 feet above gage datum. The gage is read by S. A. Hollis.

Since the establishment of this station 17 discharge measurements have been made.

The data prior to 1912, which was furnished by the Flood Commission of Pittsburgh, will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF LOYALHANNA CREEK, NEAR NEW ALEXANDRIA, WESTMORELAND COUNTY, PA.

(Drainage area 270 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
11	Dec. 7	Boehringer, ...	120	296	1.42	2.68	421	0.6 msmt.
	1913							
12	Jan. 9	Boehringer & Hinkley.	144	722	3.40	5.60	2452	Surface msmt.
13	Jan. 10	Boehringer & Hinkley.	138	558	2.87	4.40	1602	Surface msmt.
14	Jan. 10	Boehringer & Hinkley.	138	544	2.67	4.30	1451	Surface msmt.
15	Jan. 10	Boehringer & Hinkley.	138	525	2.55	4.19	1341	Surface msmt.
16	Jan. 10	Boehringer & Hinkley.	136	523	2.38	4.11	1247	Surface msmt.
17	Jan. 11	Boehringer & Hinkley.	141	577	2.89	4.52	1671	Surface msmt.

DISCHARGE TABLE FOR LOYALHANNA CREEK, NEAR NEW ALEXANDRIA, WESTMORELAND COUNTY, FROM JAN. 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.50	33	.70	400	.90	1145	.10	2100	.30	3315
.60	52	.80	445	4.00	1220	.20	2190	.40	3430
.70	72	.90	497	.10	1295	.30	2280	.50	3545
.80	95	3.00	550	.20	1370	.40	2375	.60	3660
.90	120	.10	605	.30	1445	.50	2470	.70	3775
2.00	145	.20	665	.40	1525	.60	2570	.80	3890
.10	175	.30	725	.50	1605	.70	2670	.90	4010
.20	205	.40	790	.60	1685	.80	2770	7.00	4130
.30	238	.50	860	.70	1765	.90	2875		
.40	272	.60	930	.80	1845	6.00	2980		
.50	312	.70	1000	.90	1930	.10	3090		
.60	355	.80	1070	5.00	2015	.20	3200		

Note.—This table is only applicable subsequent to Jan. 1, 1912, and is based on 7 discharge measurements made during 1912-1913, together with former curve.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF LOYALHANNA CREEK, NEAR NEW ALEXANDRIA, WESTMORELAND CO UNTY, PA.

1912	JAN.		APRIL.		MAY.		JUNE.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	3.95	1180	......	......	3.43	811	1.92	125	2.90	497	‡3.50	860	2.50	312	2.50	312	2.00	145
2,	‡3.50	860	......	......	3.23	683	1.92	125	2.90	497	5.00	2020	2.40	272	2.40	272	2.10	175
3,	3.05	578	......	......	2.93	513	1.92	125	2.80	445	5.00	2020	1.90	120	2.30	238	2.20	205
4,	2.95	523	......	......	3.33	744	1.92	125	3.50	860	5.60	2570	2.00	145	2.30	238	2.10	175
5,	3.15	635	......	......	3.33	744	2.03	151	2.40	272	4.00	1220	2.00	145	2.10	175	2.10	175
6,	3.15	635	......	......	2.53	325	1.92	125	2.30	238	3.80	1070	2.00	145	2.10	175	3.10	605
7,	3.55	895	......	......	2.73	414	1.92	125	2.20	205	3.20	665	2.10	175	2.90	497	2.90	497
8,	*3.35	758	......	......	2.73	414	1.92	125	2.20	205	3.10	605	2.00	145	2.90	497	2.50	312
9,	......	300	......	......	2.78	436	1.92	125	2.20	205	2.90	497	2.10	175	2.90	497	2.30	238
10,	......	300	......	......	2.63	368	1.72	76	2.20	205	2.70	400	2.20	205	2.80	445	2.10	175
11,	......	300	......	......	2.53	325	1.72	76	2.60	355	2.50	312	2.30	238	2.30	238	2.00	145
12,	......	300	......	......	2.53	325	1.72	76	2.70	400	2.40	272	2.20	205	2.30	238	2.00	145
13,	......	300	......	......	2.53	325	1.72	76	2.60	355	2.30	238	1.90	120	2.30	238	1.80	95
14,	......	300	......	......	2.63	368	1.62	56	2.50	312	2.30	238	1.90	120	2.20	205	2.80	445
15,	......	300	......	......	2.63	368	1.62	56	2.40	272	2.40	272	2.00	145	‡2.10	175	1.90	120
16,	......	300	......	......	2.73	414	5.22	2210	2.40	272	2.30	238	1.90	120	‡2.00	145	2.20	205
17,	......	300	......	......	3.63	951	4.92	1960	2.30	238	2.20	205	1.90	120	1.90	120	2.10	175
18,	......	300	......	......	3.23	683	b	......	2.20	205	2.20	205	2.00	145	2.20	205	2.10	175
19,	†7.95	970	......	......	‡2.98	540	......	......	2.20	205	3.70	1000	2.00	145	2.10	175	2.30	238
20,	3.65	965	......	......	2.73	414	......	......	6.40	3430	‡2.80	445	2.10	175	2.10	175	2.30	238
21,	‡3.45	825	......	......	2.63	368	......	......	6.10	3050	2.30	238	1.90	120	2.00	145	2.10	175
22,	3.25	695	......	......	2.53	325	......	......	3.50	860	2.30	238	1.90	120	1.90	120	2.00	145
23,	2.95	523	......	......	2.43	284	......	......	2.30	238	2.30	238	2.50	312	1.90	120	c2.20	205
24,	3.25	695	2.54	329	2.33	248	......	......	3.00	550	‡2.90	497	3.20	665	2.00	145	2.20	205
25,	2.85	471	2.54	329	2.33	248	......	......	3.00	550	3.50	860	4.20	1370	2.00	145	2.20	205
26,	2.65	378	2.64	378	2.33	248	......	......	2.80	445	2.30	238	4.20	1370	2.00	145	2.20	205
27,	2.55	334	2.54	329	2.43	284	......	......	2.70	400	2.50	312	4.30	1440	2.00	145	2.30	238
28,	2.45	292	2.54	329	2.43	284	......	......	2.50	312	2.50	312	‡4.35	1480	2.00	145	2.30	238
29,	2.55	334	2.84	466	2.43	284	......	......	2.90	497	2.50	312	4.40	1520	1.90	120	2.30	238
30,	2.85	471	4.31	1480	2.23	215	......	......	2.80	445	2.40	272	4.30	1440	1.90	120	2.90	497
31,	a2.55	334	......	......	2.23	215	......	......	2.80	445	......	......	2.40	272	......	......	†4.30	1440

*Frozen. Discharge Jan. 9 to 19 inclusive, estimated from Black Lick Cr. at Black Lick. †Ice went out. a Station discontinued. Re-established April 24. b Gage removed on account of repairs to bridge. Replaced July 31. c Partly frozen. ‡Interpolated.

ESTIMATED MONTHLY DISCHARGE OF LOYALHANNA CREEK, NEAR NEW ALEXANDRIA, WESTMORELAND COUNTY.

(Drainage area 270 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	527	1.952	2.250
May,	951	215	425	1.574	1.815
August,	3430	205	565	2.093	2.413
September,	2570	205	629	2.330	2.600
October,	1520	120	435	1.611	1.857
November,	497	120	220	0.815	0.910
December,	1440	95	272	1.007	1.161

Note.—Creek frozen Jan. 9-19 inclusive, discharge estimated from Black Lick Creek at Black Lick. Feb. 1-April 23, inclusive, station not in operation. June 18-July 31, inclusive, no readings taken on account of repairs to bridge.

KISKIMINETAS RIVER.

DESCRIPTION OF BASIN.

The Kiskiminetas river is the largest tributary of the Allegheny, and joins it near Freeport, approximately 30 miles above Pittsburgh, in the northwestern corner of Westmoreland county. It is known by this name as far as the mouth of Loyalhanna creek, 27 miles up, above which point it is called the Conemaugh river. The total drainage area of the stream is 1892 square miles.

The Conemaugh river proper is formed by the junction of the Little Conemaugh and Stony creek at Johnstown. The former rises in the western slope of the Alleghenies, on the eastern boundary of Cambria county, and flows northwesterly for about 30 miles to Johnstown. Stony creek rises in the high ridges of Somerset county, and flows northerly for about 40 miles to Johnstown. Both are rapid mountain streams, with steep slopes, rocky beds, and abrupt valleys. Their watersheds have been practically deforested, although the higher ridges are well timbered now with second growth. The watershed of Little Conemaugh river, including about 188 square miles, is densely inhabited, lying in the Cambria county bituminous coal field, and contains large areas of agricultural land. The Stony creek watershed is much less densely populated, although the Somerset county coal field, in the lower section, supports a large population. The upper watershed is sparsely inhabited, but little farmed, and contains considerable forest areas. The headwaters of both streams rise at an elevation of about 2,300 feet, and at Johnstown are at elevation 1,160 feet.

Below Johnstown the river follows a winding course in a general northwesterly direction, between precipitous banks and high timbered hillsides, and over a rocky bed, its slope to the mouth of Loyalhanna creek, 50 miles, being 6.8 feet per mile. From this latter point to the mouth at Freeport on the Allegheny river, the slope is at the rate of approximately 4 feet per mile.

The most important tributaries below Johnstown are Black Lick creek, drainage area approximately 412 square miles, from the north near Blairsville, and Loyalhanna creek, from the southeast. Both of these streams drain thickly populated and well cultivated areas, containing large bituminous coal fields.

The stream is lined with railroads, towns and industrial plants, while numerous coal mines are operated on the bordering hills and in the valleys of its tributaries.

The Kiskiminetas river carries vast quantities of alluvial material washed from its banks, and from the cultivated fields in its watershed, and is usually of a yellow color, due to this cause, and to the sulphur in the coal mine water of which it receives a considerable amount.

The tributaries of the Little Conemaugh above Johnstown are almost without exception used for water supply purposes, some of these containing large storage basins. At a point a short distance above Johnstown this stream has been known to be absolutely dry in seasons of drought. The lower tributaries of Stony creek, and the tributaries of the Conemaugh are similarly almost all in use for domestic or industrial supply. The main river is little used for domestic supply, but many large industrial plants use it.

The mean annual precipitation over this watershed is from 40 to 50 inches.

The discharge has been measured since May 29th, 1907, at Avonmore, approximately 24 miles above its mouth.

OHIO BASIN—STATION NO. 18.

KISKIMINETAS RIVER AT AVONMORE, PA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on May 29th, 1907, and has been maintained and operated since that date by the Water Supply Commission of Pennsylvania. It is located on the highway bridge on road leading to P. R. R. Station, Avonmore, about ¼ mile from the village of Avonmore, The channel is straight for 400 feet above and 300 feet below the station. The right bank is high and rocky, while the left bank is low and overflows. The bed is of sand and is not permanent.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is left face of lower right masonry guard fence of approach to bridge.

A standard chain gage is fastened to the handrail on the downstream side of the bridge. The length of chain from bottom of weight to the marker is 38.34 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is northwest corner of right masonry bridge seat marked "B. M.;" elevation 33.267 feet above gage datum. Bench Mark No. 2 is east rail of west track of highway crossing; elevation 35.034 feet above gage datum. The gage is read twice daily by Ralph Fickes.

Since the establishment of this station 22 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF KISKIMINETAS RIVER, AT AVONMORE, WESTMORELAND COUNTY, PA.

(Drainage area 1,720 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912.		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
20	Dec. 6,	Boehringer, ...	402	1850	1.78	6.43	8306	0.6 measurement.
21	Jan. 9.	Boehringer & Hinkley.	457	6609	4.08	17.53	26947	Surface measurement.
22	Jan. 9,	Boehringer & Hinkley.	452	6378	4.01	17.00	25600	Surface measurement.

DISCHARGE TABLE FOR KISKIMINETAS RIVER, AT AVONMORE, WESTMORELAND COUNTY, FROM MAY 29, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.42	0	7.00	5000	.60	16370	.20	33140	.80	53040
.50	30	.10	5140	.70	16635	.30	33470	.90	53420
.60	60	.20	5280	.80	16900	.40	33800	24.00	53800
.70	90	.30	5425	.90	17165	.50	34130	.10	54190
.80	125	.40	5570	13.00	17430	.60	34470	.20	54580
.90	165	.50	5720	.10	17700	.70	34810	.30	54970
2.00	205	.60	5870	.20	17970	.80	35150	.40	55360
.10	245	.70	6025	.30	18250	.90	35490	.50	55750
.20	285	.80	6180	.40	18530	19.00	35830	.60	56140
.30	330	.90	6340	.50	18810	.10	36170	.70	56530
.40	380	8.00	6500	.60	19090	.20	36510	.80	56920
.50	430	.10	6660	.70	19370	.30	36850	.90	57310
.60	480	.20	6820	.80	19650	.40	37190	25.00	57700
.70	530	.30	6985	.90	19930	.50	37540	.10	58090
.80	580	.40	7150	14.00	20210	.60	37890	.20	58480
.90	640	.50	7320	.10	20490	.70	38240	.30	58870
3.00	705	.60	7490	.20	20770	.80	38590	.40	59260
.10	770	.70	7660	.30	21050	.90	38940	.50	59650
.20	835	.80	7830	.40	21330	20.00	39290	.60	60040
.30	900	.90	8005	.50	21610	.10	39640	.70	60430
.40	970	9.00	8180	.60	21890	.20	39990	.80	60820
.50	1045	.10	8355	.70	22180	.30	40340	.90	61210
.60	1125	.20	8535	.80	22470	.40	40690	26.00	61600
.70	1205	.30	8715	.90	22760	.50	41040	.10	61990
.80	1290	.40	8900	15.00	23050	.60	41390	.20	62380
.90	1375	.50	9085	.10	23340	.70	41740	.30	62770
4.00	1460	.60	9275	.20	23640	.80	42090	.40	63160
.10	1545	.70	9465	.30	23940	.90	42440	.50	63550
.20	1630	.80	9660	.40	24240	21.00	42790	.60	63940
.30	1720	.90	9855	.50	24540	.10	43140	.70	64330
.40	1810	10.00	10050	.60	24840	.20	43490	.80	64720
.50	1910	.10	10250	.70	25140	.30	43840	.90	65110
.60	2010	.20	10450	.80	25440	.40	44190	27.00	65500
.70	2110	.30	10660	.90	25740	.50	44550	.10	65890
.80	2220	.40	10870	16.00	26050	.60	44910	.20	66280
.90	2330	.50	11080	.10	26360	.70	45270	.30	66670
5.00	2445	.60	11300	.20	26670	.80	45630	.40	67060
.10	2560	.70	11520	.30	26980	.90	45990	.50	67450
.20	2680	.80	11750	.40	27290	22.00	46350	.60	67840
.30	2800	.90	11990	.50	27600	.10	46710	.70	68230
.40	2920	11.00	12230	.60	27920	.20	47070	.80	68620
.50	3045	.10	12470	.70	28240	.30	47430	.90	69010
.60	3170	.20	12710	.80	28560	.40	47790	28.00	69400
.70	3295	.30	12960	.90	28880	.60	48150	.10	69790
.80	3420	.40	13210	17.00	29200	.60	48520	.20	70180
.90	3550	.50	13470	.10	29520	.70	48890	.30	70570
6.00	3680	.60	13730	.20	29840	.80	49260	.40	70960
.10	3810	.70	13990	.30	30170	.90	49630	.50	71350
.20	3940	.80	14250	.40	30500	23.00	50000	.60	71740
.30	4070	.90	14515	.50	30830	.10	50380	.70	72130
.40	4200	12.00	14780	.60	31160	.20	50760	.80	72520
.50	4330	.10	15045	.70	31490	.30	51140	.90	72910
.60	4460	.20	15310	.80	31820	.40	51520	29.00	73300
.70	4595	.30	15575	.90	32150	.50	51900	30.00	77300
.80	4730	.40	15840	18.00	32480	.60	52280	31.00	81300
.90	4865	.50	16105	.10	32810	.70	52660		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF KISKIMINETAS RIVER AT AVONMORE, WESTMORELAND COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SETP.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	9.65	9360	......	2800	7.85	6260	8.52	7350	9.00	8180	3.58	1110	4.38	1790	5.94	3600	6.04	3730	6.02	3710	4.92	2350	3.38	956
2, ...	8.40	7150	......	2800	6.15	3880	8.85	7920	7.70	6020	3.41	978	3.68	1190	5.21	2690	10.84	11800	5.35	2860	4.80	2220	3.30	900
3, ...	7.22	5310	......	2800	5.80	2800	10.08	10200	6.98	4970	3.30	900	3.45	1010	5.40	2920	19.06	36000	4.92	2350	4.55	1960	3.68	1190
4, ...	6.50	4330	......	2800	4.90	2330	8.54	7390	6.14	3860	3.35	935	3.88	1360	5.32	2820	15.46	24400	4.65	2060	4.24	1670	4.30	1720
5, ...	5.92	3580	......	2800	4.64	2050	7.59	5860	5.70	3300	3.24	861	3.74	1240	4.68	2090	10.08	10200	4.22	1650	3.96	1430	3.80	1290
6, ...	†	2700	......	2800	4.44	1850	6.92	4890	5.40	2920	3.15	802	3.80	1290	4.30	1720	8.38	7120	4.05	1500	3.92	1390	5.94	3600
7, ...	....	2700	......	2800	4.29	1710	6.45	4260	5.65	3230	3.15	802	3.50	1040	3.96	1430	7.35	5500	3.78	1270	4.70	2110	7.00	5000
8, ...	....	2700	......	2800	4.84	2260	7.08	5110	6.89	4850	3.15	802	3.12	783	3.77	1260	7.31	5440	3.70	1200	8.66	7590	5.95	3620
9, ...	....	2700	......	2800	6.70	4600	6.35	4140	6.62	4490	2.98	692	2.92	653	3.69	1200	6.18	3910	3.61	1130	6.96	4950	5.30	2800
10, ...	....	2700	......	2800	6.08	3780	5.90	3550	5.85	3480	2.72	540	2.80	580	3.65	1160	5.20	2680	3.92	1390	6.20	3940	4.62	2030
11, ...	....	2700	......	2800	5.30	2800	5.52	3070	5.40	2920	2.79	575	3.16	809	3.98	1440	4.75	2160	5.50	3040	5.70	3300	4.75	2160
12, ...	....	2700	......	2800	5.22	2700	5.20	2680	5.20	2680	2.76	560	3.32	914	4.82	2240	4.38	1790	4.45	1860	5.20	2680	4.42	1830
13, ...	....	2700	......	2800	7.56	5810	5.45	2980	5.50	3040	2.68	520	3.04	731	4.60	2010	4.15	1590	3.90	1380	4.98	2420	3.62	1140
14, ...	....	2700	......	2800	6.59	4450	5.60	3170	6.04	3730	2.62	490	2.88	628	4.80	2220	3.90	1380	3.60	1120	4.95	2390	3.65	1160
15, ...	....	2700	......	2800	11.70	14000	5.38	2900	5.38	2900	2.68	520	2.62	490	4.82	2240	3.80	1290	3.40	970	5.25	2740	4.06	1510
16, ...	....	2700	......	2800	15.65	25000	5.46	3000	5.85	3480	8.45	7240	3.20	835	4.40	1810	3.98	1440	3.39	963	4.70	2110	4.02	1480
17, ...	....	2700	......	2800	10.80	11800	5.40	2920	12.90	17200	16.25	26800	4.82	2240	3.90	1380	4.80	2220	3.30	900	5.02	2470	4.00	1460
18, ...	....	2700	......	2800	10.58	11300	8.85	7920	9.62	9310	9.52	9120	6.82	4760	3.62	1140	4.08	1580	3.25	868	4.25	1680	3.85	1330
19, ...	....	2700	......	2800	10.45	11000	8.90	8000	7.81	6200	7.18	5250	9.65	9370	4.22	1650	4.80	2220	3.42	985	4.16	1600	4.08	1530
20, ...	....	2700	......	2800	11.70	14000	7.45	5640	6.90	4860	5.85	3480	6.72	4620	9.46	9010	4.95	2390	3.52	1060	3.94	1410	4.42	1830
21, ...	....	2700	......	2800	b23.87	53300	6.65	4530	6.14	3860	5.32	2820	12.10	15000	7.68	5990	4.20	1630	3.72	1220	3.98	1440	4.02	1480
22, ...	....	2700	......	2800	19.74	38400	6.10	3810	5.52	3070	4.96	2400	16.60	27900	6.33	4110	3.72	1220	3.44	1000	3.86	1340	3.70	1200
23, ...	....	2700	......	2800	12.46	16000	6.10	3810	5.12	2580	4.55	1960	9.88	9820	6.75	4660	3.68	1190	5.80	3420	3.76	1260	3.40	970
24, ...	....	2700	......	2800	12.30	15600	6.04	3730	4.75	2160	4.32	1740	11.75	14100	6.75	4660	7.40	6570	8.46	7250	3.74	1240	3.55	1080
25, ...	....	2700	......	2800	13.35	18400	5.52	3070	4.42	1830	4.20	1630	13.08	17600	5.55	3110	9.60	9280	9.54	9160	3.60	1120	3.74	1240
26, ...	....	2700	......	2800	10.30	10700	5.20	2680	4.16	1600	3.90	1380	9.35	8810	4.70	2110	7.70	6020	d10.60	11300	3.68	1190	3.70	1200
27, ...	....	2700	a17.72	31600	9.00	8180	5.28	2780	3.90	1390	3.68	1190	7.60	5870	4.88	2310	11.63	13300	8.55	7400	3.58	1110	3.60	1120
28, ...	....	2700	12.27	15500	9.35	8810	6.26	4020	3.78	1270	3.52	1060	6.29	4060	5.11	2570	9.88	9820	7.20	5280	3.51	1050	4.22	1650
29, ...	....	2700	8.62	7520	11.68	13900	5.82	3450	3.75	1250	3.72	1220	5.94	3600	5.32	2820	7.55	5800	6.25	4000	3.40	970	4.09	1540
30, ...	....	2700	......	......	12.58	16300	9.12	8390	3.85	1330	4.20	1630	6.94	4920	4.88	2310	6.80	4730	5.65	3230	3.15	802	4.75	2160
31, ...	....	2700	......	......	9.80	9660	......	......	3.90	1380	......	......	6.05	3740	4.80	2220	.....	......	5.22	2700	....	....	9.82	9700

†Frozen Jan. 6-Feb. 26, incl. Ice broke and gorged Jan. 19 and gorge remained until Feb. 27, when it went out at 1:30 a. m. Daily discharge estimated from Black Lick Creek at Black Lick and climatological records. a Max. 19.20′ at 8:30 a. m.; 36500 sec. ft. b Max. 28.00′ during night; 69400 sec. ft. c Max. 22.30′ at 4:45 p. m.; 47400 sec. ft. d Max. 11.0′ at 8.30 a. m.; 12200 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF KISKIMINETAS RIVER, AT AVONMORE, WESTMORELAND COUNTY.

(Drainage area 1,720 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	3220	1.872	2.158
February,	36500	....	4390	2.552	2.752
March,	69100	1710	11100	6.453	7.440
April,	10200	2680	4770	2.773	3.094
May,	17200	1250	3980	2.314	2.668
June,	26800	490	2670	1.552	1.731
July,	27900	490	4900	2.849	3.285
August,	9010	1140	2670	1.552	1.789
September,	47100	1190	6260	3.640	4.061
October,	12200	868	2850	1.657	1.910
November,	7590	802	2130	1.238	1.381
December,	9700	900	2000	1.163	1.341
The year,	....	....	4240	2.468	33.610

Note.—Frozen Jan. 6-Feb. 26, incl. Ice broke and gorged Jan. 19 and gorge remained until Feb. 27, when it went out at 1:30 a. m. Daily discharge estimated from Black Lick creek at Black Lick, and climatological records.

SHENANGO RIVER.

DESCRIPTION OF BASIN.

The Shenango river, which forms, with the Mahoning river, at a point about 5 miles south of New Castle, Lawrence county, the Beaver river, rises in the southwestern part of Crawford county, Pennsylvania, about 5 miles southeast of Conneaut Lake, in the Pymatuning Swamp. The general course of the stream is southerly with numerous large sweeps to the east and west, crossing once for a short distance into Ohio but immediately returning into Pennsylvania. The total length from the head of Pymatuning Swamp to the junction with the Mahoning river is approximately 80 miles and the drainage area above the mouth is 1,080 square miles, of which 793 are in Pennsylvania.

The main tributaries of the stream are the Little Shenango, which joins it at Greenville, from the east; Pymatuning creek, from the west, just above Sharpsville; Big Yankee run, from the west at South Sharon; Deer creek from the west just below Pulaski; and Neshannock creek, from the east at New Castle, the latter being by far the largest, draining approximately 243 square miles.

The upper portion of the watershed lies within the once glaciated area and the main river and its major tributaries all find their sources in extensive swamp areas, while their valleys are broad and flat. Descending the main stream, however, the valley becomes more narrow and the hillsides more abrupt until near the mouth the valley again becomes wide and flat. A large portion of the watershed is under cultivation and the timber areas, except in the swamps, are not extensive.

The slope of the stream through the swamp, for the first 20 miles of its course, is at approximately 2 feet per mile, becoming a little more rapid as it descends, its fall through Mercer county being about 3 feet per mile. The total slope from its source in Pymatuning Swamp, at elevation about 1,020, to its mouth, at elevation about 760, is 260 feet, or 3.25 feet per mile.

From Greenville northward the watershed is not thickly inhabited, but southward from this point industries are more or less congested and the valley is thickly populated, becoming more so as the mouth is approached. The principal towns along the main stream, going southward, are Jamestown, Greenville, Sharpsville, Sharon, South Sharon, or Farrell, Pulaski and New Castle, the combined population of which is approximately 75,000. Some of these towns obtain their water supply from the Shenango river and the stream is very largely used by the steel plants, railroads and other industries which are numerous in this valley. A small amount of water power only is developed on this stream, largely at grist and flour mills, the total installation not amounting to over 600 horsepower.

The mean annual precipitation over the upper portion of this watershed is about 40 inches, decreasing as the mouth is approached.

The discharge of the stream has been measured since September, 1909, at Sharon, Pa., and at Turnerville, Crawford county, since February 1, 1912.

OHIO BASIN—STATION NO. 19.

SHENANGO RIVER AT TURNERVILLE, CRAWFORD COUNTY.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on February 1st, 1912, and is located on a single span, steel, through truss, highway bridge at Turnerville, the bridge having a total span of 105 feet.

The channel above and below the station is straight for 200 feet. The right bank overflows during extreme floods, while the left bank is high and is not subject to overflow. The bed is composed of gravel and is fairly permanent.

Discharge measurements are taken from the downstream side of the bridge, and by wading at a riffle below the station. The initial point for soundings is top edge of east abutment, downstream side.

A standard chain gage is fastened to the downstream hand rail. The length of chain from bottom of weight to marker is 24.54 feet. The elevation of zero is 970 feet above mean sea level. Bench Mark No. 1 is a chisel mark on the south end of the east abutment; elevation, 987.084 feet above mean sea level, or 17.084 feet above zero of gage. There is also a reference mark filed on middle upright post of downstream truss at elevation 993.104 feet above mean sea level, or 23.104 feet above zero of gage.

There is also a staff gage located on the downstream side of the east abutment, graduated from zero to 10 feet, the elevation of zero of which is 976 feet above mean sea level, and is referred to B. M. No. 1. This gage is read occasionally during ice periods and all readings taken on the same have been reduced six feet to correspond with the readings on the chain gage. The gage is read once daily by S. A. Marvin.

Since the establishment of this station 16 discharge measurements have been made.

DISCHARGE MEASUREMENTS OF SHENANGO RIVER, AT TURNERVILLE, CRAWFORD COUNTY, PA.

(Drainage area 150 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912.		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
1	Feb. 12,	Haslam, ...	80	151	0.68	5.35	102	Ice cover.
2	Mar. 8,	Ferris, ...	92	170	0.96	5.88	163	Ice cover.
3	Mar. 18,	Ferris, ...	103	902	2.25	12.14	2028	Ice cover.
4	Mar. 20,	Ferris, ...	103	839	2.27	11.50	1902	
5	Mar. 26,	Haslam, ...	103	568	1.67	8.94	948	
6	April 4,	Haslam, ...	103	648	1.71	9.73	1110	
7	April 10,	Ferris, ...	103	431	1.38	7.63	593	
8	April 30,	Ferris, ...	103	345	1.15	6.78	397	
9	April 30,	Ferris, ...	103	352	1.18	6.86	414	
10	May 30,	Haslam, ...	59	147	0.49	4.50	72	
11	Aug. 13,	Ferris, ...	55	128	0.24	4.12	31	Msmt. at riffle below station.
12	Aug. 28,	Ferris, ...	65	165	0.62	4.80	102	
13	Sept. 25,	Haslam, ...	61	153	0.52	4.61	79	
14	Sept. 30,	Langenheim, ...	56	134	0.32	4.23	43	
15	Oct. 5,	Haslam, ...	52	120	0.17	3.96	20	Msmt. at riffle below station.
	1913.							
16	May 24,	Haslam, ...	55	127	0.23	4.10	29	Msmt. at riffle below station.

DISCHARGE TABLE FOR SHENANGO RIVER, AT TURNERVILLE, CRAWFORD COUNTY, FROM FEBRUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
3.00	0.8	.90	114	.80	402	.70	880	.60	1523
.10	1.0	5.00	126	.90	422	.80	910	.70	1562
.20	1.5	.10	138	7.00	442	.90	940	.80	1602
.30	2	.20	150	.10	463	9.00	970	.90	1642
.40	3	.30	162	.20	485	.10	1000	11.00	1682
.50	5	.40	174	.30	507	.20	1030	.10	1723
.60	7	.50	187	.40	530	.30	1060	.20	1764
.70	9	.60	200	.50	555	.40	1090	.30	1805
.80	12	.70	214	.60	580	.50	1120	.40	1850
.90	16	.80	229	.70	605	.60	1155	.50	1895
4.00	22	.90	244	.80	630	.70	1190	.60	1940
.10	31	6.00	259	.90	655	.80	1225	.70	1985
.20	40	.10	275	8.00	680	.90	1260	.80	2030
.30	49	.20	291	.10	707	10.00	1296	.90	2075
.40	59	.30	308	.20	735	.10	1333	12.00	2120
.50	69	.40	325	.30	763	.20	1371	.20	2215
.60	80	.50	343	.40	791	.30	1409	.40	2310
.70	91	.60	362	.50	820	.40	1447	.60	2410
.80	102	.70	382	.60	850	.50	1485	.80	2510

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SHENANGO RIVER AT TURNERVILLE, CRAWFORD CO., PA.

1912.	FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1,	......	323	......	1120	10.40	1450	7.38	525	4.72	98	3.80	12	3.80	12	4.85	108	4.15	36	6.00	259	4.45	64
2,	......	347	......	883	10.40	1450	7.28	508	4.70	91	3.80	12	3.90	16	4.75	96	4.10	31	5.80	229	4.70	91
3,	......	385	......	568	10.50	1480	6.45	334	4.85	108	3.80	12	3.90	16	4.70	91	4.05	26	5.60	200	5.00	126
4,	......	425	......	406	9.77	1210	5.85	236	4.65	86	3.80	12	3.90	16	4.50	69	4.00	22	5.50	187	4.95	120
5,	......	389	......	305	9.83	1240	5.30	162	4.80	102	3.80	12	3.85	14	4.25	44	4.00	22	5.40	174	5.30	162
6,	......	313	......	246	9.45	1100	5.05	132	5.05	132	3.80	12	3.85	14	4.20	40	3.95	19	5.35	168	6.90	422
7,	......	217	......	191	8.60	850	4.95	120	5.00	126	3.80	12	3.80	12	4.20	40	3.90	16	5.60	200	6.65	372
8,	......	174	......	172	9.05	985	4.85	108	4.75	96	3.80	12	3.80	12	4.15	36	3.85	14	5.95	252	7.00	442
9,	......	143	......	191	9.00	970	4.85	108	4.50	69	3.75	10	3.80	12	4.05	26	3.85	14	5.80	229	6.75	392
10,	......	120	......	170	7.66	595	4.80	102	4.25	44	3.75	10	3.95	19	4.00	22	3.95	19	6.20	291	6.05	267
11,	......	108	......	153	6.89	420	4.75	96	4.10	31	3.75	10	4.05	26	3.95	19	4.20	40	6.85	316	5.75	222
12,	......	95	......	150	6.43	330	4.80	102	4.00	22	3.75	10	4.10	31	3.90	16	4.25	44	6.25	300	5.50	187
13,	......	91	......	166	6.08	264	4.80	102	4.00	22	3.80	12	4.14	35	3.85	14	4.20	40	6.05	267	5.25	156
14,	......	82	......	234	5.75	222	4.85	108	4.00	22	3.80	12	4.10	31	3.85	14	4.20	40	5.80	229	5.10	138
15,	......	79	......	636	7.23	492	5.05	132	4.00	22	3.85	14	4.00	22	3.80	12	4.10	31	5.60	200	4.90	114
16,	......	76	......	856	8.40	791	5.40	174	4.05	26	3.85	14	3.90	16	3.85	14	4.00	22	5.60	200	4.90	114
17,	......	70	......	1580	8.57	841	6.20	291	4.20	40	3.90	16	3.80	12	3.85	14	4.00	22	5.50	187	5.00	126
18,	......	64	......	2080	7.60	580	6.30	308	4.30	49	3.80	12	3.80	12	4.10	31	3.95	19	5.40	174	5.00	126
19,	......	70	......	2080	6.80	402	6.30	308	4.25	44	3.72	10	3.80	12	4.10	31	4.95	120	5.45	180	5.10	138
20,	......	84	......	1770	6.35	316	6.00	259	4.15	36	3.70	9	3.80	12	4.00	22	5.00	126	5.45	180	5.00	126
21,	......	110	10.78	1590	6.00	259	5.55	194	4.00	22	3.70	9	3.80	12	4.00	22	4.80	102	5.35	168	5.35	168
22,	......	140	9.97	1280	5.65	207	5.15	144	4.00	22	3.80	12	3.80	12	3.95	19	4.75	96	5.15	144	5.05	132
23,	......	138	9.52	1130	5.45	180	4.92	116	4.00	22	3.80	12	3.80	12	4.10	31	10.00	1300	4.95	120	5.10	138
24,	......	138	9.60	1160	5.30	162	4.80	102	3.95	19	3.85	14	3.85	14	4.80	102	11.40	1850	4.85	108	4.95	120
25,	......	140	9.37	1080	5.15	144	4.60	80	3.95	19	4.25	44	3.85	14	4.60	80	11.83	2040	4.80	102	4.70	91
26,	......	477	8.99	967	5.05	132	4.45	64	3.95	19	4.20	40	3.90	16	4.50	69	11.00	1680	4.65	86	*4.50	69
27,	......	868	8.50	820	4.95	120	4.30	49	3.90	16	4.10	31	4.80	102	4.50	69	9.80	1220	4.60	80	*4.50	69
28,	......	973	8.55	835	4.85	108	4.20	40	3.85	14	3.90	16	4.80	102	4.45	64	8.80	910	4.55	74	*4.35	54
29,	......	1100	10.41	1450	4.90	114	4.36	55	3.85	14	3.85	14	4.85	108	4.35	54	7.75	618	4.50	69	*4.35	54
30,	......	....	11.10	1720	6.83	408	4.50	69	3.85	14	3.80	12	4.90	114	4.30	40	7.00	442	4.45	64	*4.50	69
31,	......	....	11.20	1760	......	....	4.55	74	......	....	3.85	14	4.90	114	......	....	6.40	326	......	....	*6.80	402

Notes.—River frozen over Feb. 1 to March 20, inclusive, daily discharge computed from ic• curve drawn from three ice msmts. taken during Feb. and March. *Thin ice.

ESTIMATED MONTHLY DISCHARGE OF SHENANGO RIVER, AT TURNERVILLE, CRAWFORD COUNTY, PA.

(Drainage area 150 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
February,	....	....	267	1.780	1.920
March,	....	....	892	5.947	6.856
April,	1480	108	594	3.960	4.418
May,	525	40	168	1.120	1.291
June,	132	14	48	0.320	0.357
July,	44	9	15	0.100	0.115
August,	114	12	31	0.207	0.239
September,	108	12	44	0.293	0.327
October,	2040	14	365	2.433	2.805
November,	316	64	181	1.207	1.347
December,	442	54	170	1.133	1.306

Note.—River frozen over Feb. 1 to March 20, incl., daily discharge computed from ice curve drawn from three ice measurements taken during Feb. and March.

OHIO BASIN—STATION NO. 20.

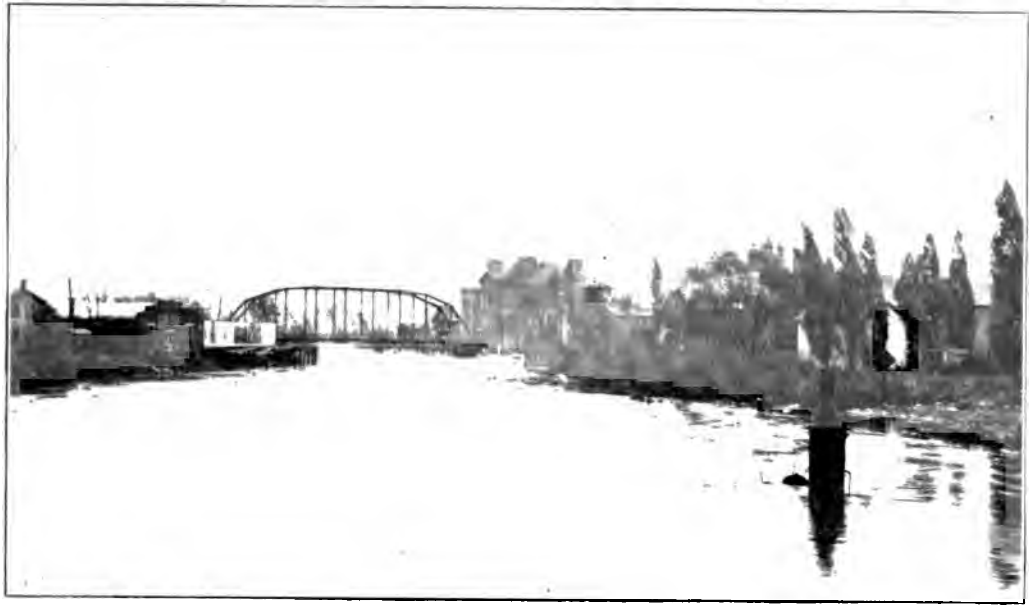
SHENANGO RIVER AT SHARON, PENNA.

DESCRIPTION OF STATION.

This station was established on August 1st, 1909, by the Carnegie Steel Company for the Water Supply Commission of Pennsylvania and is situated about fifty feet north of the Chestnut Street bridge at Sharon.

The channel above and below the station is straight for 500 feet. Both banks are approximately twelve feet above the river bed and overflow during extreme high water. The bed is composed of gravel and dirt. The current under the Chestnut Street bridge is very sluggish.

Discharge measurements are taken at numerous points; namely, Mill street bridge, State street bridge, Carnegie Plate Girder bridge, Upper Wheatland bridge, and at two wading sections, below the gage. At the Mill street bridge the measurements are taken from the upstream side, the initial point for soundings being end of hand rail, right side (looking downstream). At the State street bridge the measurements are taken from the downstream side, the initial point for soundings being the top of the left abutment. At the Carnegie Plate Girder bridge, which is two miles below the gage, the



Gaging Station on Shenango River at Sharon.

measurements are taken from the upstream side, the initial point for soundings being top of right abutment (looking downstream). At the Upper Wheatland bridge, which is 2 and one-half miles below the gage, measurements are taken from the downstream side, the initial point for soundings being face of left abutment. Wading section "A" is just south of the southern boundary line of Sharon, while wading section "B" is at South Main street, near the Atlantic Refining Company's tanks.

A staff gage is fastened to the cribbing on the right bank about 50 feet above the Chestnut street bridge. The elevation of zero is 840.00 feet above sea level. Bench Mark No. 1 is U. S. G. S. bronze tablet on southeast abutment of Chestnut street bridge, elevation 855.92 feet or 15.92 feet above gage datum. The gage is read twice daily by an employee of the Carnegie Steel Company.

Owing to the various channel conditions at the above bridge the State street bridge has been considered best for high water discharge measurements. At the Mill street bridge the section is slightly influenced by the pumping station of the North Works, which returns their pumpage just below the bridge, so that when the plant is in operation about 10 second-feet pass around this section. At the Carnegie Plate Girder bridge the section is influenced by a low dam during low water but is considered a very good section for high water discharge measurements. The Wheatland bridge is not considered good for discharge measurements, as the low water flow at this section is influenced by an eddy. Above a six foot stage, this station becomes valueless on account of the water overflowing on the west side of the bridge, while the water at all stages passes under the bridge at an angle. Discharge measurements at both the Carnegie Plate Girder bridge and the Wheatland bridge are reduced owing to the fact that the drainage area at the gage is 13 per cent. less than at these sections, due to Big and Little Yankee runs entering the parent stream below the gage.

Since the establishment of this station, 65 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF SHENANGO RIVER, AT SHARON, MERCER COUNTY, PA.

(Drainage area 605 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1913.							
61	Mar. 27,	Haslam, ...	168	2183	8.46	15.85	18480	From Mill St. bridge 10 sec.-ft. added for pumpage.
62	Mar. 27,	Haslam, ...	175	3159	5.65	15.32	17850	From State St. bridge.
63	Mar. 28,	Haslam, ...	175	2949	4.73	14.11	13960	From State St. bridge.
64	Mar. 28,	Haslam, ...	175	2826	4.42	13.60	12480	From State St. bridge.
65	Mar. 29,	Haslam, ...	168	974	6.12	10.54	5960	From Mill St. bridge 10 sec.-ft. added for pumpage.

All gage heights and discharges are referred to the Chestnut street gage.

DISCHARGE TABLE FOR SHENANGO RIVER ,AT SHARON, MERCER COUNTY, FROM AUGUST 1, 1909.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.70	20	.20	700	.70	2375	.20	6152	.70	11302
.80	23	.30	745	.80	2470	.30	6358	.80	11508
.90	27	.40	792	.90	2575	.40	6564	.90	11714
2.00	30	.50	840	7.00	2680	.50	6770	12.00	11920
.10	37	.60	890	.10	2790	.60	6976	.10	12126
.20	46	.70	940	.20	2900	.70	7182	.20	12332
.30	63	.80	990	.30	3020	.80	7388	.30	12538
.40	87	.90	1040	.40	3140	.90	7594	.40	12744
.50	112	5.00	1095	.50	3270	10.00	7800	.50	12950
.60	138	.10	1150	.60	3400	.10	8006	.60	13156
.70	164	.20	1210	.70	3535	.20	8212	.70	13362
.80	190	.30	1270	.80	3670	.30	8418	.80	13568
.90	218	.40	1335	.90	3815	.40	8624	.90	13774
3.00	248	.50	1400	8.00	3960	.50	8830	13.00	13980
.10	278	.60	1470	.10	4120	.60	9036	.50	15010
.20	310	.70	1540	.20	4280	.70	9242	14.00	16040
.30	343	.80	1610	.30	4440	.80	9448	.50	17070
.40	376	.90	1685	.40	4610	.90	9654	15.00	18100
.50	411	6.00	1760	.50	4780	11.00	9860	.50	19140
.60	448	.10	1840	.60	4960	.10	10066	16.00	20160
.70	486	.20	1920	.70	5150	.20	10272		
.80	527	.30	2010	.80	5240	.30	10478		
.90	569	.40	2100	.90	5535	.40	10684		
4.00	612	.50	2190	9.00	5740	.50	10890		
.10	655	.60	2280	.10	5946	.60	11096		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SHENANGO RIVER AT SHARON, MERCER COUNTY, PA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.	G. H.	Dis.
1, ...	7.41	3150	4.45	816	6.01	1770	8.30	4440	6.59	2270	2.94	230	2.28	60	2.40	87	4.10	655	2.72	169	4.20	700	2.90	218
2, ...	6.23	1950	4.30	745	5.50	1400	9.15	6050	5.64	1500	2.89	215	2.23	49	2.40	87	5.95	1720	2.60	138	3.95	590	3.04	260
3, ...	5.40	1340	4.27	731	4.96	1070	9.78	7350	5.04	1120	3.16	297	2.22	49	2.44	97	4.82	1000	2.56	128	3.80	527	3.45	394
4, ...	4.96	1070	4.20	700	4.51	845	8.95	5640	4.61	895	3.20	310	2.48	107	2.39	85	4.45	816	2.50	112	3.65	467	3.56	433
5, ...	3.91	573	4.17	687	4.14	673	7.69	3520	4.00	612	2.94	230	2.28	60	2.32	68	3.65	467	2.50	112	3.58	441	3.40	376
6, ...	3.68	480	3.90	569	3.84	544	7.20	2900	3.70	486	2.95	233	2.20	46	2.42	92	3.45	393	2.40	87	3.46	397	5.60	1470
7, ...	3.77	515	3.64	463	3.76	510	6.95	2630	3.56	433	3.00	248	2.29	61	2.35	75	3.59	444	2.36	77	3.68	478	5.62	1484
8, ...	3.75	506	3.50	411	3.74	502	8.00	3960	3.34	356	2.92	224	2.14	41	2.34	73	3.26	330	2.32	68	4.66	920	4.93	1056
9, ...	3.75	506	3.40	376	4.06	637	6.85	2520	3.26	330	2.78	185	2.18	44	2.40	87	2.95	233	2.38	82	4.36	773	5.60	1470
10, ...	3.96	594	3.32	350	4.10	655	6.09	1830	3.20	310	2.60	138	2.35	75	2.79	187	2.85	204	3.10	278	4.30	745	4.47	826
11, ...	3.60	448	3.25	326	3.78	511	5.40	1340	3.13	288	2.56	128	2.49	110	2.85	204	2.80	190	5.89	1680	4.36	773	4.18	691
12, ...	3.40	376	3.20	310	3.70	486	4.87	1020	3.22	317	2.49	110	2.90	218	3.50	412	2.72	169	4.60	890	4.20	700	3.70	486
13, ...	3.23	320	3.20	310	4.05	634	4.50	840	3.46	397	2.44	97	2.62	143	2.90	218	2.58	133	3.95	591	4.01	616	3.05	263
14, ...	3.21	313	3.10	278	4.04	629	4.25	722	3.58	441	2.38	82	2.46	102	2.75	177	2.50	112	3.55	429	3.88	561	3.25	326
15, ...	3.17	300	3.03	257	6.03	1780	7.97	3910	3.67	475	2.38	82	2.28	60	2.59	135	2.47	104	3.20	310	3.78	519	3.22	317
16, ...	3.20	310	2.89	215	7.09	2780	7.64	3450	3.84	544	3.54	426	2.42	92	2.50	112	2.36	77	3.00	248	3.78	519	3.27	333
17, ...	3.16	298	2.86	207	7.80	3670	6.36	2060	4.31	750	3.82	535	2.70	164	2.42	92	2.40	87	2.74	174	3.70	486	3.35	359
18, ...	3.28	336	2.91	221	8.50	4780	6.00	1760	4.36	773	3.48	404	3.05	263	2.34	73	2.55	125	2.62	143	3.60	448	3.49	408
19, ...	4.17	688	3.07	267	9.38	6520	5.32	1280	4.19	696	3.10	278	2.52	117	2.45	100	2.48	107	3.58	441	3.54	426	3.50	411
20, ...	4.48	830	3.98	608	9.10	5950	4.77	975	4.05	633	2.84	201	2.25	54	2.78	185	2.50	112	4.60	890	3.40	376	3.55	429
21, ...	4.33	760	4.36	773	8.68	5110	4.36	773	3.76	511	2.64	148	3.24	323	2.48	107	2.50	112	4.04	629	3.40	376	3.39	373
22, ...	4.19	696	4.69	885	7.88	3780	4.06	636	3.46	397	2.58	133	3.03	257	2.47	104	2.46	102	3.84	544	3.28	336	3.00	248
23, ...	3.97	600	4.32	754	7.10	2790	4.10	655	3.23	320	2.50	112	2.66	154	2.40	87	3.04	260	7.78	3640	3.15	294	3.00	248
24, ...	4.05	633	4.16	682	8.40	4610	3.86	551	3.01	251	2.45	100	4.27	732	2.48	107	4.52	850	9.52	6810	3.10	278	3.20	310
25, ...	4.00	612	4.10	655	8.05	4040	3.70	486	2.94	230	2.46	102	4.02	620	2.40	87	4.00	612	9.32	6390	3.08	272	3.00	248
26, ...	3.96	595	6.55	2230	7.08	2770	3.48	404	2.80	190	2.50	112	3.41	380	6.25	1960	3.55	429	8.82	5380	3.01	251	2.90	218
27, ...	3.70	486	7.94	3880	6.68	2360	3.42	388	2.70	164	2.42	92	3.05	263	6.06	1810	3.38	370	7.50	3270	3.00	248	2.92	224
28, ...	3.63	459	7.95	3890	7.01	2690	3.35	360	2.72	169	2.38	82	2.85	204	4.43	812	3.14	291	6.30	2010	2.95	233	2.82	196
29, ...	3.47	400	6.70	2370	8.75	5250	5.22	1220	2.70	164	2.37	80	2.75	177	4.14	673	3.00	248	5.50	1400	2.90	218	2.66	154
30, ...	4.33	759	......	....	9.80	7390	7.90	3820	2.81	193	2.30	68	2.60	138	4.07	642	2.80	190	4.90	1040	2.88	212	3.57	437
31, ...	4.64	910	......	....	9.10	5950	......	....	2.88	212	......	....	2.50	112	4.55	865	......	....	4.48	830	......	....	5.75	1575

ESTIMATED MONTHLY DISCHARGE OF SHENANGO RIVER AT SHARON, MERCER COUNTY, PA.

(Drainage area 605 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	3150	298	704	1.164	1.342
February,	3890	207	861	1.423	1.534
March,	7390	486	2680	4.430	5.107
April,	7350	360	2250	3.719	4.149
May,	2270	164	580	0.876	1.010
June,	535	63	189	0.312	0.348
July,	732	41	170	0.281	0.324
August,	1960	68	319	0.527	0.608
September,	1720	77	365	0.603	0.673
October,	6810	68	1260	2.083	2.402
November,	920	212	473	0.782	0.872
December,	1575	154	524	0.866	0.998
The year,	7390	41	860	1.422	19.367

NESHANNOCK CREEK.

DESCRIPTION OF BASIN.

Neshannock creek, the largest tributary of the Shenango river, drains approximately 245 square miles in Mercer and Lawrence counties. Rising in and passing through numerous .extensive swamp areas, in the central and eastern parts of Mercer county, its two branches, Otter and Mill creeks, join near Mercer borough, and the main stream then follows a general southerly direction for about 23 miles to its mouth at New Castle, Lawrence county, the general outline of the watershed being pear shaped. The upper sections of this stream in Mercer county flow through a deforested, rolling country, in which farming and some bituminous coal mining is carried on. The stream is sluggish in its upper portions, and the basin is covered to a great depth by deposits of glacial drift, but upon entering Lawrence county, it becomes a rapid stream, with numerous falls, flowing through a narrow gorge with high, steep walls of sandstone. From Hope Mills, Mercer county, (elevation, 1,107 feet) to New Castle, (elevation, 799 feet), a distance of 20 miles, the rate of flow is about 15 feet per mile. The chief tributaries are Otter, Mill and Little Neshannock creeks. Numerous boroughs, farming and mining villages lie in this basin, but the stream is not used for domestic water supply, and, to a limited extent, for industrial purposes, by plants in the vicinity of its mouth.

The mean annual precipitation over this watershed is from 35 to 45 inches.

The discharge has been measured since August 9, 1909, at New Castle, Pennsylvania, near the mouth.

OHIO BASIN—STATION NO. 21.

NESHANNOCK CREEK AT NEW CASTLE, PA.

DESCRIPTION OF STATION.

This station was established by the Carnegie Steel Company, in co-operation with the Water Supply Commission of Pennsylvania, on August 9, 1909, and is located at the Jefferson street bridge, New Castle, Pennsylvania.

The channel is straight for ¼ mile above and 300 yards below the station, but immediately at the station the creek makes a thirty degree bend to the right. Both banks are high, but overflow during extreme high water. The bed of the stream consists of stones, mud and slime and is not permanent. During extreme high floods in Shenango river, water may be backed up to near Jefferson street bridge, but this occurs very seldom.

Discharge measurements are taken from the downstream side of the Jefferson street bridge, and by wading either above or below the bridge. The initial point for soundings is the face of the left abutment, on the downstream side of the bridge.

Until October 8th, 1912, readings were taken from a staff gage, known as No. 2, of the three gages established by the Carnegie Steel Company, which gage was fastened to a retaining wall on the left side of the creek, just below the left bridge abutment. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a cross on the bridge wall at the left side of the bridge; elevation 6.82 feet above gage datum. Bench Mark No. 2 is a cross within a quarter circle on the outer downstream corner of the right bridge seat: elevation, 14.53 feet above gage datum. On the above date, however, this gage was replaced with a standard chain gage, which was fastened to the downstream handrail of the bridge. This gage was referred to the same datum as the staff gage, the length of chain from the bottom of the weight to the marker being 19.55 feet. The gage is read twice daily by D. B. Woolcock, Civil Engineer of the Carnegie Steel Company.

Since the establishment of this station, 16 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission. Due to a change in channel conditions, destroying the previous rating at this station, only the gage heights for 1912 have been published.

DISCHARGE MEASUREMENTS OF NESHANNOCK CREEK, AT NEW CASTLE, LAWRENCE COUNTY, PA.

(Drainage area, 240 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
	1912		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
13	March 10	D. B. Woolcock, ..	105	314	2.64	3.90	830	0.6 measurement.
14	March 25	D. B. Woolcock, ..	105	1520	9.23	18.66	14029	0.6 measurement.
15	March 28	D. B. Woolcock, ..	123	820	2.71	8.22	2222	0.6 measurement.
16	March 29	D. B. Woolcock, ..	115	521	2.79	5.74	1452	0.6 measurement.

DAILY MEAN GAGE HEIGHTS OF NESHANNOCK CREEK AT NEW CASTLE, LAWRENCE COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	4.46	....	2.84	4.00	4.76	1.84	1.42	1.58	4.46	2.12	2.42	2.05
2,	*3.34	....	2.54	b6.12	3.26	1.96	1.21	1.62	5.08	1.87	2.41	2.14
3,	*2.80	....	1.96	5.62	2.76	1.83	1.21	1.50	e5.84	1.87	2.34	2.80
4,	*2.25	....	1.80	4.54	2.80	1.71	1.58	1.54	5.58	1.96	2.32	2.50
5,	*2.04	....	1.71	4.04	2.26	1.58	1.34	1.62	4.34	1.88	2.26	2.85
6,	†	....	1.92	3.21	2.88	1.50	1.42	1.46	3.84	1.96	2.22	4.92
7,	....	....	1.92	3.55	2.71	1.42	1.35	1.50	3.62	2.04	2.44	3.38
8,	....	....	2.84	4.34	2.50	1.38	1.25	1.71	3.22	1.98	3.20	3.05
9,	....	....	2.96	3.75	2.21	1.38	1.08	2.08	2.96	1.78	2.98	2.65
10,	....	....	2.78	3.12	2.21	1.88	1.12	2.21	2.87	2.83	2.83	2.56
11,	....	....	3.25	2.92	2.21	1.33	1.12	2.79	2.71	3.28	2.72	2.43
12,	....	....	2.58	2.80	2.21	1.38	2.34	4.34	2.50	3.44	2.56	f1.90
13,	....	....	2.96	2.80	2.30	1.38	1.96	3.58	2.44	3.05	2.43	1.90
14,	....	....	2.62	3.58	2.58	1.38	1.74	2.46	2.26	2.83	2.39	1.98
15,	....	....	4.50	5.06	2.71	1.50	1.54	2.21	2.32	2.20	3.33	1.94
16,	....	....	4.71	4.71	2.92	2.58	2.04	1.58	2.50	2.00	2.38	2.05
17,	....	....	4.37	3.58	2.62	3.08	2.84	1.42	2.50	1.88	2.32	2.12
18,	....	....	4.30	3.42	2.84	2.42	3.50	1.84	2.75	1.90	2.29	2.29
19,	....	....	4.00	3.00	2.39	1.96	2.25	2.71	2.62	3.46	2.24	2.28
20,	....	....	4.08	2.75	2.21	1.75	1.75	3.75	2.38	3.40	2.23	2.20
21,	....	....	5.38	2.52	1.96	1.58	2.00	4.25	2.34	3.26	2.15	2.20
22,	....	....	4.06	2.58	1.71	1.96	3.38	2.84	2.17	2.41	2.10	2.10
23,	....	....	3.34	3.08	1.71	2.00	2.38	2.84	2.21	4.48	2.12	1.91
24,	....	....	3.58	2.70	1.71	2.12	c5.82	2.62	3.00	4.10	2.12	1.99
25,	....	....	4.21	2.50	1.71	2.00	4.08	3.26	3.00	4.24	2.13	2.11
26,	....	....	4.06	2.34	1.71	1.75	3.08	d9.77	2.71	4.14	2.08	2.20
27,	....	‡5.88	3.71	2.21	1.71	1.58	2.67	6.12	2.71	3.70	2.05	2.00
28,	....	4.17	4.00	2.54	1.71	1.50	2.17	4.62	2.50	3.15	1.90	1.98
29,	....	3.46	a6.06	4.30	1.71	1.30	2.42	4.50	2.46	2.89	1.90	2.08
30,	....	....	5.34	5.58	1.71	1.96	2.08	4.04	2.34	2.54	2.05	g2.65
31,	....	....	4.33	....	1.71	....	1.92	5.00	....	2.47	....	4.10

*Ice in creek. †Creek frozen over. ‡Ice went out about 9:00 a. m. a Max. 6.46 at 5:00 p. m. b Max. 7.04 at 5:00 p. m. c Max. 7.96 at 1:30 p. m. d Max. 13.21 at 1:00 p. m. e Max. 6.21 at 7:00 a. m. f Creek frozen across above dam. g Ice going out.

SLIPPERY ROCK CREEK.

DESCRIPTION OF BASIN.

Slippery Rock creek, the largest tributary of Connoquenessing creek, drains approximately 403 square miles in Butler, Mercer and Lawrence counties. Several branches rise in the north central portion of Butler county, and come together to form the main stream near Branchton, Butler county. The main stream flows in a general southwesterly direction following a tortuous course, its total length being approximately 43 miles. In the central section of the stream the valleys are broad and largely cultivated, as are the hills, the current being sluggish and flowing between gently sloping banks, with wide plains bordering it on either side. After the stream enters Lawrence county, the broad valleys contract to a narrow gorge, and the low sloping banks are replaced by high cliffs of massive sandstone, and the hitherto gently flowing streams become a rapid torrent.

The elevation of the stream at its source is approximately 1,400 feet above mean sea level and, at Kiesters, 14 miles below, the elevation is 1,150 feet, producing a slope of 18 feet per mile. From Kiesters to Kennedy's Mill, elevation 1,040, the stream flows through a gently sloping valley for a distance of 17 miles, having a slope of approximately 6 feet per mile. After leaving Kennedy's Mill, the creek enters the gorge which continues almost to its mouth, (elevation 580 feet) a distance of approximately 12 miles, with a fall of approximately 39 feet.

The only tributary of any importance is Muddy creek, which enters it from the east in Butler county, although there are many small tributaries entering it in Lawrence, Butler and Mercer counties.

The domestic water supply for Ellwood City and vicinity is obtained from Slippery Rock creek at its mouth. The water power of the creek is used by numerous grist mills.

The mean annual precipitation over the headwaters of the stream is from 40 to 45 inches, and over the lower reaches from 35 to 40 inches.

The discharge has been measured since January 1, 1912, near Wurtemburg, approximately 2 miles above the mouth.

SLIPPERY ROCK CREEK AT WURTEMBURG, LAWRENCE COUNTY.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on December 28th, 1911, and is located on the highway bridge across Slippery Rock creek, at the north end of Wurtemburg.

The channel above the station is straight and uniform for one-half mile, while below the station it is straight and uniform for 600 feet. The right and left banks rise abruptly. The bed is composed of gravel and is fairly permanent. Discharge measurements are taken from the upstream side of the bridge; the initial point for soundings being the west end of the north guard-rail.

A standard chain gage is fastened to the upstream side of the bridge, the length of chain from bottom of weight to marker being 35.82 feet. The elevation of zero is 817.63 feet above mean sea level. Bench Mark No. 1 is a U. S. G. S. bench in northwest abutment; aluminum tablet stamped "851 A. D. J., 1903;" elevation, 850.231 feet above mean sea level, or 32.6 feet above zero of the gage. The gage is read twice daily by Emil R. Boots.

Since the establishment of this station 18 discharge measurements have been made.

DISCHARGE MEASUREMENTS OF SLIPPERY ROCK CREEK, AT WURTEMBURG, LAWRENCE COUNTY, PA.

(Drainage area 400 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1911							
1	July 17	Langenheim, ...	28	23	2.08	2.23	48	Wading msmt. 200 yds. below Upper Wurtemburg bridge. Referenced to gage.
	1912							
2	Feb. 3	Ross, ...	.....	259	......	3.50	262	Made under ice cover.
3	Feb. 17	Ross, ...	.....	170	......	3.27	145	Made under ice cover.
4	March 21	Ross, ...	250	986	4.03	5.61	3977	
5	March 22	Ross, ...	247	844	3.32	5.03	2802	
6	March 22	Ross, ...	247	819	3.19	4.91	2614	
7	March 23	Ross	243	653	2.76	4.34	1803	
8	March 28	Ross, ...	242	604	2.77	4.06	1672	
9	April 3	Ross, ...	251	1061	4.13	5.91	4379	
10	April 3	Ross, ...	249	1010	4.08	5.69	4116	
11	April 4	Ross, ...	246	820	3.19	4.91	2613	
12	April 4	Ross, ...	244	780	3.06	4.72	2386	
13	April 8	Ross, ...	244	742	2.78	4.48	2065	
14	April 10	Ross, ...	240	498	1.90	3.48	946	
15	April 12	Ross, ...	238	405	1.54	3.13	624	
16	April 22	Ross, ...	237	326	1.26	2.84	412	
17	May 24	Ross, ...	235	272	0.87	2.54	236	
18	June 12	Ross, ...	219	192	0.42	2.21	80	

DISCHARGE TABLE FOR SLIPPERY ROCK CREEK, AT WURTEMBURG, LAWRENCE COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
2.00	20	.10	610	.20	1700	.30	3350	.40	5730
.10	30	.20	690	.30	1820	.40	3530	.50	5960
.20	50	.30	770	.40	1950	.50	3720	.60	6240
.30	80	.40	860	.50	2080	.60	3910	.70	6510
.40	130	.50	950	.60	2220	.70	4120	.80	6780
.50	190	.60	1040	.70	2360	.80	4330	.90	7060
.60	250	.70	1140	.80	2510	.90	4550	7.00	7330
.70	320	.80	1240	.90	2670	6.00	4780		
.80	390	.90	1350	5.00	2830	.10	5010		
.90	460	4.00	1460	.10	3000	.20	5250		
3.00	530	.10	1580	.20	3170	.30	5490		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF SLIPPERY ROCK CREEK AT WURTEMBURG, LAWRENCE COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	4.85	2590	......	330	3.56	1000	4.08	1560	4.56	2160	2.34	100	2.26	68	2.46	166	4.11	1590	2.51	196	2.74	348	2.56	236
2, ...	4.05	1520	......	330	3.17	666	4.96	2770	3.80	1240	2.42	142	2.21	53	2.45	160	5.08	2880	2.45	160	2.70	320	2.51	196
3, ...	3.60	1040	......	330	3.05	570	5.81	4350	3.30	770	2.42	142	2.24	62	2.39	125	6.37	5660	2.47	172	2.70	320	2.92	474
4, ...	3.25	730	......	330	2.84	418	4.77	2460	3.04	562	2.44	154	2.30	80	2.37	115	5.72	4160	2.39	125	2.62	264	3.00	580
5, ...	2.95	495	......	330	2.83	411	4.16	1650	2.87	489	2.34	100	2.18	46	2.35	105	4.49	2070	2.39	125	2.60	250	2.78	376
6, ...	2.85	425	......	330	2.88	446	3.75	1190	3.00	530	2.27	71	2.18	46	2.36	110	3.79	1230	2.34	100	2.57	232	3.56	1000
7, ...	....	350	......	330	2.80	390	3.81	1250	3.17	666	2.30	80	2.22	56	2.31	85	3.53	977	2.30	80	2.64	278	3.72	1160
8, ...	....	350	......	330	2.89	453	4.41	1960	2.92	474	2.26	68	2.21	53	2.29	77	3.17	666	2.29	77	3.00	580	3.24	722
9, ...	....	350	......	330	3.46	914	3.80	1240	2.78	376	2.26	68	2.20	50	2.39	125	2.95	495	2.39	125	2.97	509	2.96	502
10, ...	....	350	......	330	3.42	878	3.48	982	2.70	320	2.20	50	2.36	110	2.40	130	2.81	397	2.55	220	2.82	404	2.92	474
11, ...	....	350	......	330	3.08	594	3.28	754	2.62	264	2.19	48	2.32	90	2.37	115	2.71	327	2.88	446	2.81	397	2.76	363
12, ...	....	350	......	330	2.92	474	3.12	626	2.65	285	2.22	56	2.30	80	2.37	115	2.65	285	2.74	348	2.80	390	2.71	327
13, ...	....	350	......	330	3.22	706	3.17	686	2.92	474	2.24	62	2.34	100	2.41	136	2.57	232	2.60	250	2.73	341	2.72	334
14, ...	....	350	......	330	3.32	788	3.30	770	3.03	554	2.20	50	2.28	74	2.45	160	2.55	220	2.49	184	2.68	306	2.82	404
15, ...	....	350	......	330	4.74	2420	3.95	1400	2.98	516	2.25	65	2.24	62	2.37	115	2.55	220	2.48	178	2.69	313	2.76	363
16, ...	....	350	......	330	5.44	3610	3.79	1230	3.21	698	4.04	1510	2.26	68	2.29	77	2.75	355	2.42	142	2.74	348	2.57	282
17, ...	....	350	......	330	4.82	2540	3.28	754	3.76	1200	4.88	2640	2.20	50	2.28	74	2.65	285	2.42	142	2.71	327	2.64	278
18, ...	....	350	......	330	4.46	2080	4.30	1820	3.20	690	3.61	1050	2.40	130	2.27	71	2.63	271	2.38	120	2.64	278	2.68	306
19, ...	....	350	......	330	4.23	1740	3.18	674	2.90	460	2.90	460	2.38	120	2.25	65	2.69	313	2.73	341	2.64	278	2.67	299
20, ...	....	350	......	330	4.21	1710	3.00	530	2.76	362	2.67	299	2.32	90	3.01	588	2.66	292	3.12	626	2.60	250	2.60	250
21, ...	....	350	......	330	5.24	3240	2.84	418	2.67	299	2.51	196	3.01	538	3.41	869	2.49	184	2.76	362	2.58	288	2.70	320
22, ...	....	350	......	330	5.04	2900	2.78	341	2.58	238	2.56	226	3.99	1450	3.55	995	2.45	160	2.66	292	2.54	214	2.66	298
23, ...	....	350	......	330	4.25	1760	2.92	474	2.48	178	2.50	190	3.04	562	2.90	460	2.55	220	3.30	690	2.48	178	2.62	264
24, ...	....	350	......	330	4.82	2540	2.90	460	2.50	190	2.42	142	a4.66	2300	2.81	397	3.19	682	3.88	1330	2.52	202	2.66	298
25, ...	....	350	......	330	4.82	2540	2.78	376	2.42	142	2.38	120	4.48	1990	2 65	285	2.87	439	3.67	1110	2.52	202	2.63	271
26, ...	....	350	‡6.10	5010	4.26	1770	2.81	397	2.40	130	2.37	115	3.52	968	b5.37	3480	2.69	313	4.08	1560	2.58	288	2.60	250
27, ...	....	350	6.00	4780	4.42	1980	2.70	320	2.38	120	2.35	105	3.00	530	7.11	7640	2.68	306	3.56	1000	2.53	208	2.64	278
28, ...	....	350	4.96	2770	3.88	1830	2.64	278	2.38	120	2.34	100	2.69	313	4.97	2780	2.59	244	3.14	642	2.51	196	2.64	278
29, ...	....	350	3.99	1450	5.18	3140	3.86	1810	2.42	142	2.31	85	2.76	362	4.33	1860	2.53	208	2.98	516	2.54	214	2.70	320
30, ...	....	350	......	......	5.12	3080	5.58	3870	2.44	154	2.37	115	2.89	453	3.79	1230	2.47	172	2.84	418	2.58	238	2.82	404
31, ...	....	350	......	......	4.48	2060	....	......	2.42	142	....	......	2.62	264	4.19	1690	....	......	2.68	306	....	......	4.26	1770

Creek frozen Jan. 7-Feb. 25, inclusive, discharge estimated from Shenango River at Sharon. ‡Ice went out. a Max. 5.65 at 5:30 p. m.; 4020 sec. ft. b Max. 8.17 at 5:30 p. m.; 10800 sec. ft.

ESTIMATED MONTHLY DISCHARGE OF SLIPPERY ROCK CREEK, AT WURTEMBURG, LAWRENCE COUNTY.

(Drainage area 400 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	502	1.255	1.447
February,	5010	....	768	1.920	2.071
March,	3610	390	1580	3.950	4.554
April,	4350	278	1230	3.075	3.430
May,	2160	120	480	1.200	1.383
June,	2640	48	287	0.718	0.801
July,	4020	46	362	0.905	1.044
August,	10800	65	785	1.962	2.262
September,	5660	160	862	2.155	2.404
October,	1560	77	399	0.998	1.151
November,	580	178	294	0.735	0.820
December,	1770	196	437	1.092	1.259
The year,	....	....	666	1.664	22.636

Note.—Creek frozen Jan. 7-Feb. 25, inclusive, discharge estimated from Shenango River at Sharon.

CHEAT RIVER.

DESCRIPTION OF BASIN.

The Cheat river, or its uppermost branch, the Shavers Fork, rises in the northern part of Pocahontas county, W. Va., and flows in a general northwesterly direction to its mouth in the Monongahela river, at Point Marion, Fayette county, Pa., about 90 miles below Pittsburgh, Pa., a distance of approximately 157 miles, 4 miles of which is in Pennsylvania. It drains an area of approximately 1,427 square miles, of which 98 lies in Pennsylvania. The source is in the point of coalescence of Back, Allegheny Mountain and Cheat Mountain, at elevation of approximately 4,500 feet, from which it falls to elevation 780 feet at its mouth, the total fall being 3,720 feet, or at the rate of 23.6 feet per mile. The river proper, which is formed by the junction of Shavers Fork and Dry Fork, at Parsons, W. Va., is at elevation 1,625 feet, and has a slope of approximately 11 feet per mile to its mouth, a distance of about 78 miles. The drainage basin of Shavers Fork is very long and narrow, while that of Dry Fork is notably fan-shaped. The headwaters of this river lie in a rough, mountainous region, many of the valleys being in deep gorges, with swiftly flowing mountain streams. The Cheat river, from the source of Shavers Fork for half its length, lies in a narrow steep sided and uncultivated gorge, with the mountain slopes heavily timbered. Above Parsons, W. Virginia, for a distance of a few miles, the valley opens out with the stream flowing through low bottom land or flood plains. Below this point for a distance of 9 miles it passes through a steep-sided, broad valley, with cultivated and unusually level bottoms, the course of the stream being very tortuous. From this point to Mont Chateau, W. Va., there are numerous small patches of cultivated bottom land, while below this point the river then enters Pennsylvania through another gorge, which extends to its mouth.

Owing to the fact that the basin of this stream is long and narrow, being 100 miles in length by about 14 miles in width, together with other topographical features, condusive to the same result, the Cheat river has a rapidly, fluctuating discharge, rising quickly in great floods, and reducing rapidly thereafter.

Approximately three-fourths of the entire drainage area is reported to be forest covered and coal is mined over a large portion of this watershed. There are very few towns of importance in this drainage basin, the largest being Rowlesburg and Parsons, W. Va., and Point Marion, Pa., which latter community uses this stream as a source of domestic water supply.

The mean annual precipitation over this watershed is from approximately 40 to 45 inches.

The discharge has been measured since July, 1899, at Ice's Ferry, near Morgantown, W. Va.

OHIO BASIN—STATION NO. 23.

CHEAT RIVER NEAR MORGANTOWN, W. VA.

DESCRIPTION OF STATION.

This station, which was maintained from July 8th, to December 30th, 1899, July 1st to December 29th, 1900, and August 21st, 1902, to December 31st, 1905, by the United States Geological Survey, was re-established November 18th, 1908, by F. W. Scheidenhelm, of the Pittsburgh Hydro Electric Company, and has been maintained and operated since this later date.

A complete description of the old gages operated prior to 1908 may be found in the 1910-11 Report of the Water Supply Commission.

The present gaging station is located at the highway bridge at Uneda, W. Va., ten miles above the mouth of the river.

The channel is probably permanent. Ice conditions may effect the relation of gage height to discharge during several months of the year.

Discharge measurements are made from the upstream side of the bridge, or by wading during low water.

A standard chain gage is attached to the highway bridge, the length of chain from the bottom of the weight to the marker being 41.01 feet. The elevation of zero is arbitrary. Bench Mark No. 1 is a mark on the face of sandstone rock in edge of bank beside road, 20 feet downstream and 30 feet back from gage; elevation, 21.13 feet above gage datum.

Since the establishment of the station, 25 discharge measurements have been made.

The following data have been furnished by the U. S. Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF CHEAT RIVER, NEAR MORGANTOWN, W. VA.

(Drainage area 1,380 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1911							
21	Oct. 7	Drake, ...	385	3.080	2.12	4.87	6,400	0.6 method.
	1912							
22	March 22	Drake, ...	425	4,060	5.61	8.18	22,800	Surface msmt.
23	July 25	Drake, ...	509	6,060	6.98	12.27	42,300	Surface msmt.
	1913							
24	Jan. 8	Drake, ...	465	4,690	6.52	9.55	30,550	Surface msmt.
25	Jan. 8	Drake, ...	465	4,690	6.50	9.55	30,500	Surface msmt.

DISCHARGE TABLE FOR CHEAT RIVER, NEAR MORGANTOWN, WEST VIRGINIA.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.50	115	.40	1520	.30	8530	.20	18220	.10	27910
.60	140	.50	1780	.40	9040	.30	18730	.20	28420
.70	165	.60	1955	.50	9550	.40	19240	.30	28930
.80	190	.70	2200	.60	10060	.50	19750	.40	29440
.90	220	.80	2450	.70	10570	.60	20260	.50	29950
2.00	255	.90	2710	.80	11080	.70	20770	.60	30460
.10	290	4.00	3000	.90	11590	.80	21280	.70	30970
.20	330	.10	3300	6.00	12100	.90	21790	.80	31480
.30	375	.20	3620	.10	12610	8.00	22300	.90	31990
.40	425	.30	3960	.20	13120	.10	22810	10.00	32500
.50	480	.40	4320	.30	13630	.20	23320	11.00	37600
.60	545	.50	4700	.40	14140	.30	23830	12.00	42700
.70	625	.60	5110	.50	14650	.40	24340	13.00	47800
.80	710	.70	5550	.60	15160	.50	24850	14.00	52900
.90	805	.80	6020	.70	15670	.60	25360	15.00	58000
3.00	915	.90	6500	.80	16180	.70	25870		
.10	1045	5.00	7000	.90	16690	.80	26380		
.20	1185	.10	7510	7.00	17200	.90	26890		
.30	1340	.20	8020	.10	17710	9.00	27400		

Note.—This table has been revised above gage height 4.2′ and is based on discharge measurements 22 to 25. This table applies to all years 1902-12 with proper change of gage heights 1902-09 by curve of relation as explained in 1910-11 Report of Water Supply Commission.

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CHEAT RIVER NEAR MORGANTOWN, W. VA.

1912.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1,	6.7	15700	4.45	4510	4.5	4700	4.9	6500	4.25	3790	2.75	668	3.85	2580	4.4	4320	3.75	2330	3.7	2200	2.9	805	2.55	512
2,	5.4	9040	4.1	3300	4.0	3000	4.6	5110	4.15	3460	2.65	585	3.55	1840	4.2	3620	5.0	7000	3.55	1840	2.9	805	2.65	585
3,	4.7	5550	3.75	2320	3.9	2710	5.2	8020	3.85	2580	2.6	545	3.25	1260	3.9	2710	4.4	4320	3.35	1430	2.85	758	3.2	1180
4,	4.35	4140	3.3	1340	3.65	2080	5.1	7510	3.7	2200	2.65	585	3.8	2450	3.7	2200	3.95	2860	3.2	1180	2.85	758	3.3	1340
5,	4.05	3150	2.95	860	3.45	1620	4.5	4700	3.5	1780	2.6	545	4.8	6020	3.3	1340	3.6	1960	3.05	980	2.75	668	3.35	1430
6,	3.65	2080	3.15	1120	4.4	4320	4.3	3960	3.4	1520	2.5	480	5.0	7000	3.25	1260	3.35	1430	3.0	915	2.75	668	3.5	1730
7,	3.3	1340	2.95	860	3.3	1340	4.05	3150	3.45	1620	2.5	480	4.1	3300	3.15	1120	3.15	1120	2.9	805	....	a3680	5.0	7000
8,	3.1	1040	2.95	860	3.35	1430	4.05	3150	3.6	1960	2.5	480	3.55	1840	3.05	980	3.1	1040	2.8	710	6.9	16700	4.4	4320
9,	3.35	1430	2.65	585	4.0	3000	4.1	3300	4.15	3460	2.6	545	3.3	1340	3.0	915	2.95	860	2.75	668	5.4	9040	3.95	2860
10,	3.2	1180	....	a548	4.3	3960	3.85	2580	3.85	2580	2.4	425	3.2	1180	3.05	960	2.85	758	2.75	668	4.5	4700	3.65	2080
11,	3.1	1040	2.55	512	3.95	2860	3.7	2200	3.6	1960	2.35	400	3.1	1040	3.05	980	2.7	625	2.7	625	4.05	3150	3.45	1620
12,	3.05	980	2.65	555	3.8	3450	3.6	1960	3.6	1960	2.25	352	4.0	3000	3.1	1040	2.65	585	2.6	545	3.9	2710	3.35	1430
13,	3.0	915	2.75	668	4.15	3460	3.5	1730	6.2	13100	2.15	310	3.85	2580	3.0	915	2.65	585	2.6	545	3.65	2080	3.2	1180
14,	2.9	805	2.85	758	5.0	7000	3.5	1730	5.6	10100	2.15	310	3.45	1620	2.9	805	2.65	585	2.6	545	3.65	2080	3.15	1120
15,	2.9	805	2.9	806	7.8	21300	3.5	1730	4.7	5550	2.3	330	3.3	1340	3.35	1430	2.55	512	2.55	512	3.6	1960	3.2	1180
16,	2.85	758	....	a715	9.3	28900	3.45	1620	6.0	12100	2.5	480	4.0	3000	3.2	1180	2.6	545	2.5	480	3.5	1730	3.15	1120
17,	2.8	710	2.7	625	6.3	13600	3.85	2580	7.5	19800	3.0	915	4.5	4700	3.1	1040	2.65	585	2.45	452	3.35	1430	3.1	1040
18,	2.95	860	2.75	668	5.4	9040	4.6	5110	5.7	10600	3.65	2080	4.5	4700	2.9	805	3.25	1260	2.45	453	3.25	1280	3.0	915
19,	....	a548	3.05	980	5.0	7000	4.8	6020	5.0	7000	4.4	4320	7.3	18200	3.05	960	3.3	1340	2.45	452	3.2	1180	3.05	980
20,	5.6	10100	3.95	2860	6.1	12600	4.25	3790	4.45	4510	4.3	3960	5.0	7000	3.95	2860	3.2	1180	2.5	480	3.1	1040	3.15	1120
21,	4.7	5550	9.2	28400	9.4	29400	3.95	2860	4.05	3150	4.05	3150	4.9	6500	3.95	2860	2.9	805	2.45	452	3.05	980	3.1	1040
22,	4.15	3460	8.8	26400	8.3	23800	3.75	2320	3.8	2450	3.6	1960	7.7	20800	3.6	1960	2.8	710	2.6	545	2.95	860	3.1	1040
23,	4.0	3000	6.6	15200	6.2	13100	3.7	2200	3.55	1840	3.65	2080	6.0	12100	3.6	1960	3.3	1340	2.65	585	2.9	805	2.85	758
24,	4.0	3000	5.5	9550	7.1	17700	3.7	2200	3.4	1520	3.9	2710	8.7	25900	3.35	1430	6.1	12600	2.85	758	2.9	805	....	a734
25,	3.85	2580	4.2	3620	7.0	17200	3.6	1960	3.35	1430	3.7	2300	12.0	42700	3.2	1180	6.3	13100	3.95	2860	2.9	805	2.8	710
26,	3.65	2080	5.7	10600	5.8	11100	3.45	1620	3.1	1040	3.9	2710	7.2	18300	3.25	1260	5.3	8530	3.9	2710	2.85	758	2.8	710
27,	3.65	2080	9.9	32000	5.0	7000	4.2	3620	3.0	915	3.65	2080	5.3	8530	3.25	1260	5.4	9040	3.65	2080	2.8	710	2.85	758
28,	3.4	1520	6.6	15200	4.5	4700	4.35	4140	2.95	860	3.5	1730	4.5	4700	3.4	1520	4.5	4700	3.45	1620	2.7	625	3.1	1040
29,	3.45	1620	5.3	8020	5.0	7000	4.1	3300	2.9	805	3.5	1730	4.3	3960	3.6	1960	4.1	3300	3.25	1260	2.65	585	3.25	1260
30,	5.7	10600	....	......	6.9	16700	4.2	3620	3.05	980	4.8	6020	6.3	13100	4.15	3460	3.9	2710	3.1	1040	2.6	545	4.05	3150
31,	5.1	7510	....	......	5.7	10600	....	......	2.9	805	....	......	4.9	6500	3.85	2580	....	......	3.0	915	....	......	6.9	16700

a Interpolated.

ESTIMATED MONTHLY DISCHARGE OF CHEAT RIVER NEAR MORGANTOWN, W. VA.

(Drainage area 1,380 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	15700	710	3550	2.57	2.96
February,	32000	512	6020	4.36	4.70
March,	29400	1340	9510	6.89	7.94
April,	8020	1620	3480	2.52	2.81
May,	19800	805	4110	2.98	3.44
June,	6020	310	1510	1.09	1.22
July,	42700	1040	7710	5.59	6.44
August,	4320	805	1710	1.24	1.43
September,	13100	512	2940	2.13	2.38
October,	2560	452	1010	.73	.84
November,	16700	545	2320	1.68	1.87
December,	16700	512	2020	1.46	1.68
The year,	42700	310	3820	2.77	37.71

TYGART RIVER

DESCRIPTION OF BASIN.

The Tygart, also called Tygart's Valley river, rises in the southern part of Randolph county, W. Va., and flows in a general northerly direction to its junction with the West Fork river, near Fairmount, W. Va.

Its length is approximately one hundred miles while its drainage area, above the mouth, is approximately 1,420 square miles. The elevation of the hills at the source is approximately 3,500 feet, while at its mouth the elevation is about 860 feet. In the upper portions the country is mountainous, the slopes of the valleys steep and, in many places, precipitous and the fall of the stream is rapid. As the river approaches its confluence with the West Fork it flows through a rolling country. There are no lakes, ponds or swamps on the drainage area and the flow is flashy. There are many tributaries, the largest of which are Buchanan river and Middle Fork river. Its watershed is underlain by very valuable and extensive coal beds and contains oil and gas in abundance. At the headwaters there is still some timber, but over the general basin the mountains are sparsley forested. There are several large towns in the drainage basin, the most important of which are Grafton and Phillipi. Little water power has been developed although the main stream and its tributaries afford ample opportunity.

The mean annual precipitation over this watershed is from 45 to 50 inches.

The discharge has been measured since 1907, at Fetterman and Bellington, W. Va.

OHIO BASIN—STATION NO. 24.

TYGART RIVER AT FETTERMAN, WEST VIRGINIA.

DESCRIPTION OF STATION.

This station was established on June 3rd, 1907, by the United States Geological Survey, who have maintained and operated it since that date. It is located on the iron, highway bridge, about 1,000 feet from the B. & O. R. R. station at Fetterman, Taylor county, W. Va., and about 18 miles above the mouth.

The channel is straight for over 500 feet above and below the station. The banks are high and not subject to overflow. The bed of the stream is hard and firm.

Discharge measurements are taken from the downstream side of the bridge, the initial point for soundings being the face of the right abutment, downstream side of bridge.

A standard chain gage is located on the left of the middle pier on the downstream side of the bridge. The length of chain, from the bottom of the weight to the marker is 36.14 feet. Bench Mark No. 1 is the southwest corner of the lower right abutment of the bridge, marked with black paint; elevation 31.46 feet above gage datum, which is 957.86 feet above sea level. Bench Mark No. 2 is the northeast corner of upstream end of pier; elevation, 31.44feet above gage datum. A reference point is a file mark on the upstream and right edges of the first vertical compression member from the abutment, downstream side of left span, marked above and below with black paint, elevation, 37.01 feet above gage datum. The gage is read twice daily by Joseph Gerken.

Since the establishment of this station, 18 discharge measurements have been made.

The following data have been furnished by the United States Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF TYGART RIVER, AT FETTERMAN, WEST VIRGINIA.

(Drainage area 1,340 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
13	1912 Sept. 2	Bailey, ...	272	1646	1.13	5.06	1860	0.2 and 0.8 method.

DISCHARGE TABLE FOR TYGART RIVER, AT FETTERMAN, WEST VIRGINIA, FROM JUNE 3, 1907 TO DECEMBER 31, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
2.00	4	.50	1040	7.00	5370	.50	10050	12.00	15060
.10	6	.60	1176	.10	5554	.60	10240	.10	15284
.20	9	.70	1324	.20	5738	.70	10430	.20	15508
.30	12	.80	1484	.30	5922	.80	10620	.30	15732
.40	16	.90	1650	.40	6107	.90	10810	.40	15956
.50	20	5.00	1820	.50	6292	10.00	11000	.50	16180
.60	25	.10	1990	.60	6477	.10	11190	.60	16404
.70	32	.20	2162	.70	6662	.20	11380	.70	16628
.80	40	.30	2334	.80	6848	.30	11570	.80	16852
.90	50	.40	2506	.90	7034	.40	11760	.90	17076
3.00	63	.50	2680	8.00	7220	.50	11950	13.00	17300
.10	80	.60	2854	.10	7406	.60	12140	14.00	19600
.20	103	.70	3030	.20	7592	.70	12330	15.00	21900
.30	134	.80	3206	.30	7780	.80	12520	16.00	24300
.40	172	.90	3382	.40	7968	.90	12710	17.00	26700
.50	218	6.00	3560	.50	8156	11.00	12900	18.00	29100
.60	268	.10	3738	.60	8344	.10	13116	19.00	31600
.70	323	.20	3916	.70	8532	.20	13332	20.00	34100
.80	384	.30	4096	.80	8720	.30	13548	21.00	36600
.90	451	.40	4276	.90	8910	.40	13764	22.00	39100
4.00	525	.50	4456	9.00	9100	.50	13980	23.00	41700
.10	607	.60	4638	.10	9290	.60	14196	24.00	44300
.20	699	.70	4820	.20	9480	.70	14412		
.30	802	.80	5002	.30	9670	.80	14628		
.40	916	.90	5186	.40	9860	.90	14844		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF TYGART RIVER AT FETTERMAN, WEST VIRGINIA.

1912.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	9.4	9860	7.0	5370	6.1	3740	7.2	5740	5.25	2250	3.88	438	4.75	1400	5.4	2510	6.2	3920	4.3	802	3.70	323	3.68	312
2, ...	7.4	6110	6.0	3560	5.8	3210	6.4	4280	5.3	2330	3.83	404	4.5	1040	5.2	2160	5.3	2330	4.2	699	3.68	312	3.72	335
3, ...	6.4	4280	5.7	3030	5.6	2850	7.4	6110	5.2	2160	3.68	312	4.25	750	5.0	1820	4.65	1250	4.1	607	3.58	258	3.78	372
4, ...	5.8	3210	5.4	2510	5.2	2160	7.1	5550	4.95	1740	3.68	312	4.15	653	4.8	1480	5.05	1900	4.0	525	3.50	218	3.88	438
5, ...	5.5	2680	5.1	1990	4.9	1650	6.3	4100	4.7	1320	3.66	301	5.05	1900	4.4	916	4.7	1320	3.98	510	3.50	218	4.15	653
6, ...	4.9	1650	a5.0	1820	4.75	1400	5.8	3210	4.55	1110	3.70	323	5.3	2330	4.25	750	4.2	699	3.78	372	3.50	218	5.6	2850
7, ...	4.75	1400	5.0	1820	4.7	1320	5.3	2330	4.55	1110	3.90	451	5.2	2160	4.1	607	4.0	525	3.60	268	4.2	699	6.1	3740
8, ...	4.7	1320	a4.7	1320	4.55	1110	5.5	2680	4.7	1320	3.76	360	4.25	750	4.05	566	3.95	488	3.50	218	8.6	8340	5.7	3030
9, ...	4.5	1040	a4.55	1110	5.0	1820	5.4	2510	5.7	3030	3.70	323	4.25	750	3.99	518	3.85	418	3.42	181	7.6	6480	5.5	2680
10, ...	4.95	1740	a4.4	916	5.7	3030	5.3	2330	5.7	3030	3.56	248	4.35	859	3.97	508	3.72	335	3.40	172	6.0	3560	5.4	2510
11, ...	5.30	2330	4.3	802	5.7	3030	5.15	2080	5.2	2160	3.48	210	4.65	1250	3.95	488	3.60	268	3.40	172	5.25	2250	4.6	1180
12, ...	5.25	2250	a4.3	802	5.6	2850	4.95	1740	5.15	2080	3.46	200	4.25	750	4.0	525	3.58	258	3.40	172	4.8	1480	4.2	699
13, ...	a4.9	1650	a4.3	802	6.7	4820	4.8	1480	10.6	12100	3.28	128	4.15	653	4.2	699	3.52	228	3.38	164	4.6	1180	4.1	607
14, ...	4.8	1480	4.5	1040	8.8	8720	4.6	1180	8.2	7590	3.18	87	4.1	607	3.92	466	3.45	195	3.35	153	4.5	1040	4.0	525
15, ...	4.8	1480	a4.2	699	12.0	15100	4.65	1250	6.8	5000	3.23	112	3.95	488	4.0	525	3.38	164	3.50	218	4.4	916	4.0	525
16, ...	4.7	1320	a4.0	525	14.8	21400	4.5	1040	8.9	8910	3.36	157	3.87	431	3.97	508	3.35	153	3.48	209	4.3	802	4.0	525
17, ...	4.5	1040	a4.3	802	11.6	14200	4.35	859	12.8	16900	3.70	323	4.1	607	3.95	488	3.18	98	3.42	181	4.3	802	4.05	566
18, ...	4.5	1040	a4.6	1180	8.1	7410	6.3	4100	9.1	9290	4.0	525	5.6	2850	3.87	431	3.25	118	3.40	172	4.2	699	4.15	653
19, ...	10.7	12300	4.9	1650	6.7	4820	6.2	3920	7.3	5920	4.7	1320	9.0	9100	3.87	431	4.1	607	3.42	181	4.1	607	4.05	566
20, ...	12.1	15300	6.3	4100	8.8	8720	5.7	3030	6.3	4100	4.8	1480	7.2	5740	4.7	1320	4.1	607	3.38	164	4.0	525	3.95	488
21, ...	8.4	7970	8.5	8160	10.2	11400	5.15	2080	5.45	2590	4.75	1400	5.7	3030	4.5	1040	3.85	418	3.35	153	4.0	525	3.9	451
22, ...	7.2	5740	10.0	11000	11.2	13300	5.05	1900	5.1	1990	4.55	1110	9.7	10400	4.45	978	3.78	372	3.30	134	4.0	525	3.85	422
23, ...	6.0	3560	7.9	7080	9.2	9480	4.9	1650	4.8	1480	4.75	1400	12.3	15700	4.45	978	4.3	802	3.42	181	3.98	510	3.95	488
24, ...	5.6	2850	7.0	5370	10.4	11800	4.95	1740	4.55	1110	4.85	1570	7.2	5740	4.4	916	6.2	3920	3.52	228	3.95	488	4.0	525
25, ...	5.45	2590	6.2	3920	10.8	12500	4.95	1740	4.4	916	5.05	1900	24.4	45300	4.25	750	6.4	4280	3.65	296	3.95	488	4.05	566
26, ...	5.4	2510	7.5	6290	7.7	6660	4.75	1400	4.25	750	5.8	3210	15.4	22900	4.15	653	5.9	3380	3.68	312	4.0	525	4.1	607
27, ...	5.1	1990	14.0	19600	6.8	5000	5.05	1900	4.05	566	5.7	3030	7.5	6290	4.5	1040	5.3	2330	3.95	488	3.98	510	4.25	750
28, ...	4.85	1570	10.7	12800	6.1	3740	5.2	2160	3.96	495	5.35	2420	5.8	3210	4.4	916	4.8	1480	4.0	525	3.90	451	4.6	1180
29, ...	5.8	3210	7.1	5550	6.0	3560	5.1	1990	3.93	478	5.0	1820	5.3	2330	4.45	978	4.6	1180	3.90	451	3.90	451	4.8	1480
30, ...	11.7	14400	......	......	10.2	11400	5.15	2080	3.98	510	4.65	1250	5.7	3030	4.35	859	4.4	916	3.82	397	3.75	354	6.6	4640
31, ...	9.2	9480	......	......	9.0	9100	....	......	3.90	451	....	......	5.8	3210	4.2	699	....	......	3.78	372	....	......	12.2	15500

a Gage height to top of ice. It is not believed relation of gage height to discharge was affected during 1912.

ESTIMATED MONTHLY DISCHARGE OF TYGART RIVER, AT FETTERMAN, WEST VIRGINIA.

(Drainage area 1,340 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	15300	1040	4170	3.11	3.58
February,	19600	525	3970	2.96	3.19
March,	21400	1110	6820	5.09	5.87
April,	6110	859	2610	1.95	2.18
May,	16960	451	3380	2.52	2.90
June,	3210	87	904	.675	.75
July,	45300	431	5040	3.76	4.34
August,	2510	431	888	.663	.76
September,	4280	98	1170	.873	.97
October,	802	134	312	.233	.27
November,	8840	218	1190	.888	.99
December,	15500	312	1610	1.20	1.38
The year,	45300	87	2680	2.00	27.18

WEST FORK RIVER.

DESCRIPTION OF BASIN.

The West Fork river rises in the western part of Upshur county, W. Va., and flows northwestward into Lewis county, thence flowing in a slight northeasterly direction to its junction with the Tygart river near Fairmount, W. Va.

Its length is approximately seventy miles and its drainage area, above the mouth, is about 845 square miles. The elevation of the hills at the source is about 1,500 feet, while at its mouth the elevation is about 860 feet. It flows through a broad valley, the bordering hills being steep and precipitous and slightly forested. There are no lakes, ponds or swamps on the drainage area. There are numerous tributaries, the largest of which are Ten Mile creek, Simpson creek and Stone Coal creek. Its watershed is underlain by very valuable and extensive coal beds and contains oil and gas in abundance. There are several large towns in the drainage area, the most important of which are Clarksburg and Weston.

Little water power has been developed, although the main stream and its tributaries afford ample opportunity.

The mean annual precipitation over this watershed is between 45 and 50 inches.

The discharge has been measured since 1907, at Enterprise, W. Va., 33 miles above the mouth.

WEST FORK RIVER AT ENTERPRISE, W. VA.

DESCRIPTION OF STATION.

This station was established on June 2, 1907, by the United States Geological Survey, who has maintained and operated it since that date, and is located at the steel highway bridge at Enterprise, Harrison county, W. Va., about three-fourths of a mile above the mouth of Bingaman creek, and about 12 miles above the mouth.

The channel is broken by one pier; the bed being smooth rock and permanent. Both banks are high and not subject to overflow.

Discharge measurements are made from the downstream side of the bridge at ordinary stages, and by wading at a point 200 feet above the bridge at low stages.

A standard chain gage is attached to the bridge. The length of chain from the bottom of the weight to the marker is 37.95 feet. Elevation of zero is 869.91 feet above sea level. Bench Mark No. 1 is the northeast corner of the left abutment, downstream side of bridge; elevation 33.70 feet above gage datum. Bench Mark No. 2 is northwest corner, downstream end of pier; elevation, 33.87 feet above gage datum. Reference point is a scratch on west side of third vertical member, downstream side of bridge about 0.44 feet above top of handrail, elevation, 39.80 feet above gage datum.

A small dam is located at Worthington, W. Va., about 3 miles below the station, but backwater does not reach the section.

Ice may affect the relation of gage height to discharge for two or three weeks at a time, during December, January and February. During the summer of 1908 the only water running in the river was the pumpage from the numerous coal mines along the stream.

Since the establishment of this station, 18 discharge measurements have been made.

The following data have been furnished by the U. S. Geological Survey. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF WEST FORK RIVER, AT ENTERPRISE, WEST VIRGINIA.

(Drainage area 750 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
18	Aug. 28	Bailey, ...	154	374	0.89	2.22	334	0.2 and 0.8 method.

DISCHARGE TABLE FOR WEST FORK RIVER, AT ENTERPRISE, WEST VIRGINIA FROM JUNE 2, 1907 TO DEC. 31, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.00	0	.60	489	.20	2362	.80	5070	.40	8158
.10	1	.70	540	.30	2456	.90	5180	.50	8280
.20	2	.80	598	.40	2552	8.00	5290	.60	8404
.30	4	.90	649	.50	2650	.10	5400	.70	8528
.40	6	3.00	707	.60	2750	.20	5510	.80	8652
.50	9	.10	767	.70	2850	.30	5625	.90	8776
.60	12	.20	829	.80	2950	.40	5740	11.00	8900
.70	16	.30	893	.90	3050	.50	5855	.10	9025
.80	20	.40	959	6.00	3150	.60	5970	.20	9150
.90	25	.50	1026	.10	3252	.70	6085	.30	9275
1.00	30	.60	1094	.20	3356	.80	6200	.40	9400
.10	36	.70	1163	.30	3460	.90	6320	.50	9525
.20	43	.80	1233	.40	3564	9.00	6460	.60	9650
.30	52	.90	1304	.50	3670	.10	6580	.70	9775
.40	64	4.00	1377	.60	3776	.20	6700	.80	9900
.50	79	.10	1451	.70	3882	.30	6820	.90	10025
.60	99	.20	1526	.80	3988	.40	6940	12.00	10150
.70	124	.30	1602	.90	4094	.50	7060	13.00	11450
.80	155	.40	1680	7.00	4200	.60	7182	14.00	12750
.90	190	.50	1759	.10	4308	.70	7304	15.00	14100
2.00	237	.60	1840	.20	4416	.80	7426	16.00	15450
.10	266	.70	1922	.30	4524	.90	7548	17.00	16850
.20	307	.80	2006	.40	4632	10.00	7670		
.30	350	.90	2092	.50	4740	.10	7792		
.40	395	5.00	2180	.60	4850	.20	7914		
.50	441	.10	2270	.70	4960	.30	8036		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF WEST FORK RIVER AT ENTERPRISE, W. VA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	7.2	4420	4.3	1600	3.5	1080	5.5	2650	2.75	566	1.71	127	1.96	212	3.05	787	2.4	395	2.5	441	1.60	99	1.40	64
2, ...	6.1	3250	3.7	850	3.2	829	4.2	1530	2.65	514	1.66	114	1.86	176	2.65	514	2.3	350	2.3	350	1.52	83	1.40	64
3, ...	4.3	1600	......	850	2.9	649	7.3	4520	2.6	489	1.61	102	1.81	158	2.25	328	2.2	307	1.00	30	1.51	81	1.38	62
4, ...	3.7	1000	......	850	2.7	540	5.7	2850	2.55	465	1.47	74	1.77	146	1.95	208	2.15	286	1.00	30	1.60	99	1.80	155
5, ...	4.0	1000	......	850	2.4	395	5.2	2360	2.5	441	1.46	78	1.74	136	1.80	155	2.0	227	1.90	190	1.60	99	2.05	246
6, ...	......	1000	......	850	2.3	350	4.7	1920	2.35	372	1.36	59	1.72	130	1.70	124	1.82	162	1.70	124	1.55	89	3.0	707
7, ...	......	1000	......	850	2.2	307	4.0	1380	2.4	395	1.36	59	1.71	127	1.70	124	1.72	130	1.64	109	1.70	124	5.6	2750
8, ...	......	1000	......	850	2.1	266	3.7	1160	2.6	489	1.26	48	1.66	114	1.69	122	1.70	124	1.60	99	3.2	829	4.5	1760
9, ...	......	1000	......	850	3.9	1300	3.25	861	2.55	465	1.26	48	1.67	116	1.69	122	1.60	99	1.55	89	4.2	1530	3.0	707
10, ...	......	1000	......	850	3.4	959	3.05	787	2.5	441	1.26	48	1.85	172	1.67	116	1.52	83	1.50	79	3.3	898	2.4	395
11, ...	......	1000	3.05	850	3.0	707	2.9	649	2.45	418	1.26	48	1.80	155	1.67	116	1.40	64	1.50	79	2.4	395	2.3	350
12, ...	......	1000	......	850	2.7	540	2.65	514	2.25	328	1.26	48	1.75	140	1.67	116	1.40	64	1.48	76	2.1	266	2.1	266
13, ...	3.45	1000	......	850	9.9	7350	2.65	514	2.3	350	1.18	42	1.70	124	1.67	116	1.42	67	1.45	72	2.0	227	1.90	190
14, ...	......	1000	......	850	9.0	6460	2.6	489	2.15	286	1.06	34	1.65	112	1.66	114	1.35	58	1.40	64	2.0	227	1.85	172
15, ...	......	1000	......	850	11.8	9900	2.6	489	2.05	246	0.96	28	1.73	133	1.65	112	1.31	58	1.40	64	1.98	220	1.80	155
16, ...	......	1000	......	850	12.2	10400	6.2	3360	2.05	246	0.96	28	1.55	89	1.65	112	1.30	52	1.30	52	1.92	197	1.70	124
17, ...	......	1000	......	850	9.0	6460	4.2	1530	3.6	1090	1.46	78	2.25	328	1.65	112	1.30	52	1.60	99	1.85	172	1.70	124
18, ...	......	1000	......	850	6.3	3460	3.9	1300	4.2	1530	2.35	372	1.85	172	1.85	172	1.30	52	1.55	89	1.80	155	1.80	155
19, ...	13.8	1000	......	850	4.0	1380	3.25	861	3.7	1160	2.35	372	1.75	140	6.6	3780	1.25	48	1.40	64	1.80	155	1.90	190
20, ...	9.2	6700	......	850	4.8	2010	2.95	678	3.45	992	2.3	350	3.15	798	5.0	2180	1.22	45	1.30	52	1.75	140	2.0	227
21, ...	6.5	3670	7.4	4630	8.9	6320	2.9	649	3.15	798	2.2	307	2.95	678	3.8	1230	1.21	44	1.35	58	1.70	124	1.95	208
22, ...	4.0	1380	11.5	9520	7.6	4850	2.65	514	2.95	678	2.15	286	4.0	1390	2.55	465	2.10	266	1.30	52	1.70	124	1.82	162
23, ...	4.2	1530	6.2	3360	7.7	4960	2.5	441	2.75	566	2.1	266	6.6	3780	2.15	286	2.6	489	1.20	43	1.65	112	1.8	155
24, ...	3.8	1230	4.4	1680	6.5	3670	2.35	372	2.7	540	2.55	465	3.6	1090	2.05	246	6.6	3780	1.10	36	1.62	104	1.76	143
25, ...	3.6	1090	3.8	1230	9.2	6700	2.2	307	2.45	418	2.4	395	16.6	16300	1.95	208	6.5	2650	1.90	190	1.60	99	1.70	124
26, ...	3.4	959	4.0	1330	7.5	4740	2.15	286	2.25	328	1.26	48	8.1	5400	1.90	190	4.2	1530	1.80	155	1.56	91	1.60	99
27, ...	3.3	893	12.2	10400	7.2	4420	2.05	246	2.05	246	2.2	307	6.0	3150	2.65	514	4.6	1840	1.80	155	1.52	83	1.80	155
28, ...	3.0	707	8.2	5510	6.1	3250	1.97	216	1.96	212	2.05	246	5.4	2550	2.25	328	4.0	1380	1.75	140	1.50	79	3.0	707
29, ...	2.9	649	5.3	2460	5.0	2180	1.97	216	1.96	212	1.96	212	4.1	1450	2.1	266	3.8	1230	1.72	130	1.48	76	3.7	1160
30, ...	7.5	4740	......	......	8.0	5290	2.8	593	1.88	183	1.96	212	3.6	1090	2.0	227	3.4	959	1.70	124	1.42	67	4.2	1530
31, ...	5.4	2550	......	......	6.3	3460	....	......	1.76	143	....	......	3.05	737	1.90	190	....	......	1.60	99	....	......	6.5	3670

Ice conditions existed Jan. 4-19 and Feb. 2-20. Discharge estimated from gage heights and climatological records.

ESTIMATED MONTHLY DISCHARGE OF WEST FORK RIVER, AT ENTERPRISE, WEST VIRGINIA.

(Drainage area 750 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	1660	2.21	2.55
February,	10400	....	2000	2.67	2.88
March,	10400	266	3400	4.53	5.22
April,	4520	216	1140	1.52	1.70
May,	1530	143	503	.671	.77
June,	465	28	163	.217	.24
July,	16300	89	1330	1.77	2.04
August,	3780	112	440	.587	.68
September,	3780	44	563	.751	.84
October,	441	30	111	.148	.17
November,	1530	67	235	.313	.35
December,	3670	62	548	.731	.84
The year,	....	....	1010	1.35	18.28

Note.—Ice conditions existed Jan. 4-19 and Feb. 2-20. Discharge estimated from gage heights and climatological records.

DUNKARD CREEK.

DESCRIPTION OF BASIN.

Dunkard creek, a tributary of the Monongahela river in Monongahela county, West Virginia, and Green county, Pennsylvania, drains an area of approximately 235 square miles, of which 125 square miles lie in Pennsylvania. Rising in two forks, Pennsylvania and West Virginia forks, the former heading in the south central part of Green county, and the latter in the western part of Monongahela county, W. Virginia, which join on the Pennsylvania-West Virginia line, the stream follows a general easterly direction through a rolling, well settled, farming country, practically deforested, with many turns, crossing and recrossing the state line to its mouth, three miles below Point Marion, Pennsylvania. The distance from the forks to the mouth is about 36 miles.

The West Virginia Fork rises at an elevation of about 1,300 feet, and the Pennsylvania Fork at an elevation of about 1,400 feet. The junction lies at an elevation of 975 feet, and the mouth at an elevation of 800 feet. The forks have an approximate slope of 30 feet per mile, whereas the fall from the junction to the mouth is at the rate of 5 feet per mile. The principal tributaries are Pennsylvania and West Virginia forks. There are only a few small villages and one borough in this basin, none of which use the water of this stream for domestic supply. This creek in the fall of 1908 was absolutely dry at a point a short distance above its mouth.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since October 14th, 1909, at "Bobtown," about two miles above the mouth.

OHIO BASIN—STATION NO. 26.

DUNKARD CREEK AT "BOBTOWN," PA.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania, in co-operation with the Flood Commission of Pittsburgh, on October 14th, 1909, and is located on a single span, covered wooden bridge at "Bobtown," about two miles above its mouth.

The channel above and below the station is straight. Both banks are high and do not overflow. The bed is rocky and is mostly of solid rock and is permanent. There is a deep, quiet pool under the bridge at low stages with very sluggish velocity. The creek goes dry during every period of drought.

Discharge measurements are made from the downstream side of the bridge during floods and by wading during low stages. The initial point for soundings is top edge of bridge seat, left abutment.

A twelve foot staff gage is bolted to the downstream wing of the left abutment. The elevation of zero is arbitrary datum. Bench Mark No. 1 is shelf on top of second course from bottom, third stone in from face; elevation, 2.64 feet above zero of gage. The gage is read twice daily by Frank South.

Since the establishment of this station, 3 discharge measurements have been made. Owing to the insufficient number of discharge measurements, no rating curve has been computed for this station,

Gaging Station on Dunkard Creek, at Bobtown, Greene Co.

and only the discharge measurement and daily gage heights have been published. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF DUNKARD CREEK, AT "BOBTOWN," GREENE COUNTY, PA.

(Drainage area 230 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
3	1912 Dec. 5	Boehringer, ...	40	38	1.24	1.50	47	0.6 msmt.

DAILY MEAN GAGE HEIGHTS OF DUNKARD CREEK AT "BOBTOWN," GREEN COUNTY, PA.

1912.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
DAY.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.	G. H.
1,	3.95	2.04	2.28	2.63	3.20	1.20	1.44	1.68	1.30	1.28	1.06	1.00
2,	2.95	1.96	2.08	2.66	2.60	1.20	1.36	1.58	1.28	1.24	1.01	1.13
3,	2.60	1.90	b1.84	3.25	2.28	1.12	1.24	1.52	1.55	1.18	1.01	1.14
4,	2.35	b1.87	1.82	2.80	2.10	1.10	1.16	1.42	1.43	1.16	e0.98	1.18
5,	2.08	b1.90	1.76	2.56	1.98	1.06	1.22	1.34	1.28	1.12	0.95	1.46
6,	*2.20	1.85	1.72	2.32	1.84	1.01	1.70	1.30	1.26	1.10	0.95	2.15
7,	2.18	1.75	1.70	2.14	2.02	1.01	1.44	1.28	1.22	1.11	1.08	2.59
8,	2.32	1.70	1.80	2.20	2.44	0.96	1.28	1.25	1.20	1.06	1.78	2.10
9,	*2.52	1.72	2.20	2.02	2.12	0.92	1.18	1.17	1.78	1.01	1.76	1.85
10,	2.70	1.72	2.18	1.92	1.95	0.86	1.09	1.14	1.46	0.96	1.58	1.62
11,	2.40	1.70	2.05	1.81	1.78	0.82	1.01	1.12	1.34	0.91	1.48	1.50
12,	2.30	1.58	2.03	1.78	1.81	0.78	1.00	1.18	1.22	0.98	1.38	1.50
13,	2.20	1.42	4.50	1.77	2.34	0.75	1.76	1.15	1.16	0.99	1.30	b1.60
14,	2.15	1.50	3.50	1.88	2.10	0.73	1.42	1.36	1.11	0.92	1.30	1.36
15,	2.10	1.67	6.00	2.70	1.90	0.88	1.28	1.90	1.10	0.88	1.25	1.30
16,	2.05	1.68	4.15	2.40	2.18	1.10	2.10	1.62	1.10	0.81	1.22	1.24
17,	2.02	1.71	3.07	2.16	2.88	1.22	4.47	1.42	1.04	0.78	1.19	1.24
18,	2.35	1.82	2.72	3.27	2.55	1.34	3.15	1.31	1.10	0.80	1.18	1.27
19,	†5.98	2.04	2.49	2.78	2.25	1.45	2.95	1.28	2.22	0.88	1.16	1.32
20,	‡	2.40	3.87	2.38	2.09	1.34	2.25	1.28	1.69	0.86	1.16	1.29
21,	2.88	cf5.17	6.20	2.16	1.92	1.32	2.04	1.20	1.45	0.84	1.14	1.30
22,	2.49	4.65	4.50	2.08	1.68	1.40	4.28	1.23	1.32	0.82	1.13	b1.40
23,	2.52	2.80	3.40	1.95	1.59	1.30	2.60	2.06	2.25	0.92	1.08	1.37
24,	2.72	2.56	4.55	1.80	1.48	1.20	5.05	2.08	3.55	0.96	1.06	1.22
25,	2.47	2.40	4.15	1.72	1.40	1.14	d7.43	1.68	2.12	1.06	1.08	1.18
26,	2.82	4.37	3.10	1.58	1.36	1.18	3.16	1.50	1.74	1.30	1.01	b1.20
27,	2.17	4.95	2.68	1.88	1.30	1.15	2.80	1.38	1.62	1.20	1.04	1.22
28,	2.15	2.95	2.48	2.15	1.26	1.15	2.06	1.30	1.58	1.18	1.08	*1.45
29,	1.97	2.56	3.56	2.05	1.24	1.18	1.92	1.30	1.44	1.13	e1.02	1.70
30,	2.39	....	4.18	3.82	1.25	1.46	2.08	1.24	1.34	1.10	0.99	c3.08
31,	2.28	....	3.02	....	1.21	....	1.85	1.50	....	1.08	....	g4.22

*Channel below gage obstructed by ice. †Ice running. ‡Ice gorge. b Channel filled with ice. c Ice went out on this date. d Max. 8.30 in early a. m. e Creek frozen over. f Max. 6.90 during night of 21st. g Max. 5.20 in early a. m.

TURTLE CREEK.

DESCRIPTION OF BASIN.

Turtle creek, a tributary of the Monongahela river in Allegheny and Westmoreland counties, drains an area of approximately 145 square miles. Rising in the western part of Westmoreland county, it flows in a southwesterly direction along the Allegheny county line to where it is joined by its largest tributary, Brush creek, and thence through Allegheny county to its mouth, just above Braddock borough, a total distance of about 20 miles. The basin is fan-shaped and the area drained is a rolling, agricultural country, only seven per cent. being forested, the upper section being entirely devoted to farming, whereas the lower section, along the valley, is congested by railroads and industrial establishments. The entire watershed is densely inhabited, many large and prosperous boroughs lying along the stream. This stream rises at an elevation of approximately 756 feet, making the average slope about 25 feet per mile, but there are numerous stretches of this stream which are flat, showing only a slope of from 5 to 9 feet per mile. In the lower section the channel is filled to a considerable depth with silt. Only one borough receives a domestic water supply from a tributary of Turtle creek, although many manufacturing establishments use the water for industrial purposes.

The mean annual precipitation over this watershed is from 35 to 40 inches.

The discharge has been measured since December 1st, 1907, at East Pittsburgh, about 1½ miles above the mouth.

OHIO BASIN—STATION NO. 27.

TURTLE CREEK AT EAST PITTSBURGH, PA.

DESCRIPTION OF STATION.

This station was established on December 1st, 1907, by the Water Supply Commission of Pennsylvania, and is located on the Cable avenue viaduct from the P. R. R. depot to Westinghouse Works, in East Pittsburgh.

The channel is straight above and below the station and is walled in for 1,000 feet, while there is a low dam 200 feet downstream. Both banks are high and do not overflow except in high backwater floods from the Monongahela river. The bed is composed of gravel and muddy clay and is somewhat shifting.

Discharge measurements are made from the downstream side of the Cable avenue viaduct, the initial point for soundings being a point on the downstream handrail directly above top edge coping of left bridge seat.

Prior to December 11, 1912, a 16 foot staff gage was fastened to the right abutment, downstream corner, the elevation of zero being 722.88 feet. Bench Mark No. 1 is top of right abutment, downstream corner; elevation, 746.63 feet, or 23.75 feet above gage datum. On December 11, 1912, however, the staff gage was replaced by a standard chain gage fastened to the outside of the downstream handrail, the length of chain being 40.25 feet, and was referenced to the original datum. The gage is read twice daily by the Westinghouse Electric & Mfg. Company, East Pittsburgh.

This station is within reach of backwater floods from the Monongahela river.

Since the establishment of this station, 13 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF TURTLE CREEK, AT EAST PITTSBURGH, ALLEGHENY COUNTY, PA.

(Drainage area 145 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
12	1912 Dec. 11	Boehringer, ...	87	107	1.10	1.33	118	0.6 msmt.
13	1913 April 4	Boehringer & Knight.	98	138	1.60	1.63	221	0.6 msmt.

DISCHARGE TABLE FOR TURTLE CREEK, AT EAST PITTSBURGH, ALLEGHENY COUNTY, FROM DEC. 1, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
.20	10	.30	345	.40	1235	.50	2640	.60	4795
.30	11	.40	380	.50	1290	.60	2730	.70	4900
.40	12	.50	415	.60	1345	.70	2820	.80	5010
.50	15	.60	450	.70	1400	.80	2910	.90	5120
.60	19	.70	485	.80	1455	.90	3000	9.00	5230
.70	24	.80	520	.90	1510	7.00	3100	.10	5335
.80	30	.90	555	5.00	1570	.10	3200	.20	5440
.90	37	3.00	595	.10	1630	.20	3300	.30	5545
1.00	45	.10	635	.20	1690	.30	3405	.40	5655
.10	60	.20	675	.30	1750	.40	3510	.50	5765
.20	75	.30	715	.40	1810	.50	3615	.60	5875
.30	90	.40	755	.50	1875	.60	3725	.70	5985
.40	110	.50	800	.60	1940	.70	3835	.80	6095
.50	130	.60	845	.70	2005	.80	3945	.90	6200
.60	150	.70	890	.80	2075	.90	4055	10.00	6305
.70	175	.80	935	.90	2150	8.00	4165	.10	6410
.80	200	.90	980	6.00	2225	.10	4270	.20	6515
.90	225	4.00	1025	.10	2300	.20	4375	.30	6620
2.00	255	.10	1075	.20	2380	.30	4480	.40	6725
.10	285	.20	1125	.30	2465	.40	4585	.60	6830
.20	315	.30	1180	.40	2550	.50	4690		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF TURTLE CREEK AT EAST PITTSBURGH, ALLEGHENY COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	2.40	380	1.50	130	1.88	220	2.50	415	2.70	485	1.66	165	1.97	246	2.06	270	2.60	450	1.55	140	1.57	144	1.35	100
2, ...	2.70	485	1.46	122	1.80	200	3.45	778	2.60	450	1.67	168	1.80	200	1.96	240	f4.90	1510	1.50	130	2.35	362	1.70	175
3, ...	2.56	436	1.40	110	1.75	188	3.40	755	2.50	415	1.92	231	1.80	200	1.90	225	4.80	1460	1.53	136	3.20	675	1.60	150
4, ...	2.20	315	1.60	150	1.70	175	2.50	415	2.49	412	1.70	175	1.80	200	1.94	237	2.90	555	1.61	152	1.60	150	1.75	188
5, ...	2.00	255	1.50	130	1.65	162	2.46	401	2.29	342	1.65	162	1.70	175	1.75	188	2.40	380	1.61	152	1.60	150	1.60	150
6, ...	1.95	240	1.50	130	1.66	162	2.45	398	2.42	387	1.62	155	1.76	190	1.30	90	3.40	755	1.71	178	1.83	208	g3.40	755
7, ...	1.75	188	1.45	120	1.60	150	3.05	615	2.62	457	1.61	152	1.50	130	1.30	90	2.65	468	1.67	144	2.20	315	2.20	315
8, ...	1.58	146	1.60	150	1.55	140	2.60	450	2.48	408	1.60	150	1.70	175	1.40	110	2.75	502	1.43	116	2.55	432	1.90	225
9, ...	1.50	130	2.95	575	2.10	285	2.48	408	2.44	394	1.59	148	1.70	175	1.30	90	2.45	398	1.50	130	2.76	506	1.95	240
10, ...	1.45	120	1.85	212	1.25	82	2.35	362	2.31	348	1.47	124	1.60	150	2.00	255	1.95	240	1.47	124	2.60	450	1.87	218
11, ...	1.45	120	1.40	110	1.30	90	2.42	387	2.40	380	1.55	140	1.80	200	2.80	520	1.96	240	1.45	120	2.25	330	1.61	152
12, ...	1.42	114	1.40	110	2.50	415	2.40	380	2.55	432	1.51	132	1.85	212	2.05	270	1.92	231	1.40	110	1.85	212	0.84	33
13, ...	1.40	110	1.48	126	3.12	643	2.70	485	2.88	548	1.50	130	1.70	175	1.95	240	1.70	175	1.55	140	1.90	225	1.05	52
14, ...	1.40	110	1.50	130	2.12	291	2.45	398	2.88	548	1.49	128	1.80	200	1.60	150	1.50	130	1.65	162	1.98	249	1.20	75
15, ...	1.30	90	1.52	134	6.62	2750	2.20	315	2.48	408	1.51	132	1.50	130	1.40	110	1.65	162	1.56	140	1.90	225	1.68	170
16, ...	1.20	75	1.54	138	*4.84	1480	2.15	300	2.96	587	c5.25	1720	1.58	146	1.48	126	1.75	188	1.59	148	1.55	140	1.90	225
17, ...	1.20	75	1.55	140	3.05	615	2.10	285	2.56	415	3.50	800	1.59	148	1.46	122	1.50	130	1.61	152	1.50	130	1.08	57
18, ...	2.25	330	1.70	175	2.20	315	2.86	541	2.46	401	2.35	362	5.06	1600	1.40	110	1.48	126	1.47	124	1.53	136	1.15	63
19, ...	3.40	755	2.30	345	2.00	255	2.20	315	2.22	321	2.12	291	2.80	520	1.80	200	1.50	130	1.61	152	1.64	160	1.25	82
20, ...	1.88	220	2.90	555	2.82	527	2.06	278	2.06	273	1.95	240	1.90	225	1.70	175	1.42	114	1.68	158	1.80	200	0.92	39
21, ...	1.88	220	a5.22	1700	b11.82	h8220	2.15	300	2.06	279	2.05	270	7.10	3200	2.20	315	1.65	162	1.56	142	1.60	150	1.10	60
22, ...	1.50	130	2.60	450	*7.52	3640	2.20	315	2.00	255	2.15	300	3.15	655	1.90	225	1.60	150	1.68	170	1.35	100	1.25	82
23, ...	2.00	255	1.88	220	3.22	683	2.18	309	1.96	225	2.08	279	2.60	450	2.60	450	1.55	140	1.60	150	1.40	110	1.10	60
24, ...	2.46	398	1.75	188	4.65	1370	2.25	330	1.85	212	2.02	261	d9.58	5860	1.80	200	1.62	155	1.65	162	1.40	110	1.10	60
25, ...	1.95	240	1.95	240	3.38	747	2.15	300	1.80	200	1.90	225	*4.90	1500	1.45	120	1.45	120	1.68	158	1.40	110	1.10	60
26, ...	1.78	195	4.45	1260	2.90	555	2.30	345	1.80	200	1.70	175	*4.15	1000	1.90	225	1.60	150	2.10	285	1.35	100	0.85	34
27, ...	1.50	130	*2.75	502	2.70	485	2.62	457	1.77	192	1.50	130	3.75	912	2.50	415	1.62	155	2.00	255	1.45	120	1.25	82
28, ...	1.50	130	*2.25	330	2.95	575	2.24	327	1.74	185	1.48	126	2.70	485	1.80	200	1.62	155	1.50	130	1.15	68	1.25	82
29, ...	2.85	538	1.90	225	4.55	1320	2.90	555	1.71	178	1.46	122	2.45	398	1.70	175	1.80	200	1.48	126	1.35	100	1.40	110
30, ...	2.70	485	......	......	3.40	755	2.90	555	1.59	148	1.51	132	2.15	300	2.90	555	1.58	146	1.53	136	1.35	100	2.62	457
31, ...	1.75	188	......	......	2.65	468	....	......	1.68	170	.....	......	2.00	255	e5.95	2190	......	......	1.74	185	....	.....	2.20	315

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*Backwater from Monongahela River; gage heights reduced to free flow equivalent. a Max. 7.50 at 4:45 p. m.; 3620 sec. ft. b Max. 12.80 at 11:30 a. m.; h9250 sec. ft. c Max. 649 at 4:45 p. m.; 2630 sec. ft. d Max. 12.48 at 4:30 p. m.; h8900 sec. ft. e Max. 7.38 at 4:45 p. m.; 3490 sec. ft. f Max. 5.78 at 4:45 p. m.; 2060 sec. ft. g Max. 3.87 at 8:30 a. m.; 966 sec. ft. h Estimated.

ESTIMATED MONTHLY DISCHARGE OF TURTLE CREEK, AT EAST PITTSBURGH, ALLEGHENY COUNTY, PA.

(Drainage area 145 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	755	75	245	1.690	1.948
February,	3620	110	307	2.117	2.283
March,	h9250	82	902	6.221	7.172
April,	778	273	416	2.869	3.201
May,	587	148	344	2.372	2.734
June,	2680	122	258	1.779	1.985
July,	h8900	130	658	4.588	5.232
August,	3490	90	287	1.979	2.282
September,	3060	114	329	2.269	2.532
October,	285	110	152	1.048	1.209
November,	675	68	216	1.490	1.662
December,	966	33	157	1.083	1.249
The year,	h9250	33	356	2.455	33.489

Note.—h Estimated.

YOUGHIOGHENY RIVER.

DESCRIPTION OF BASIN.

The Youghiogheny river, the largest tributary of the Monongahela river, drains an area of approximately 1,800 square miles in Maryland, West Virginia and Pennsylvania, of which about 1,265 square miles lie in Pennsylvania. Rising near the Maryland-West Virginia boundary line, in Preston county, West Virginia , to the north of the headwaters of the Potomac river, and upon the western side of Great Savage Mountain, its course is almost due north, roughly paralleling the Monongahela river, between Negro Mountain, on the east, and Briary Mountain, on the west, it crosses the state line near Watsondale, at the junction of Fayette and Somerset counties.

On the upper reaches of this river the grade is steep, but the valley is open and rolling. It soon becomes more mountainous, however, and the stream flows between high, steep hills, ending abruptly at the water's edge, the channel being strewn with numerous boulders and large stones. The river continues northward in this manner, gradually loosing its swiftness, but still retaining the hilly nature, to Somerfield, Pa., two miles above the state line, where the slope of the stream is more uniform and continues as such to its junction with the Casselman river. From Confluence, where it is joined by its largest tributary, Casselman river, to its mouth the river follows a general northwesterly direction, the valley being narrow and steep, and to Bidewell the stream flows at a fairly uniform grade, gradually developing into rapids with the valley assuming a more gorge-like form. Just above Ohiopyle the stream becomes very rapid, assuming its greatest fall as it makes a long loop around the mountain. Between Connellsville and West Newton the stream cuts through a succession of ridges, alternating with rolling country on either side, and from this point to its mouth the valley is wide and rolling.

The total length of this river is about 125 miles, of which approximately 83 miles lie in Pennsylvania. The elevation of the source is approximately 3,000 feet, and at the point where the Youghiogheny enters Pennsylvania the elevation is 1,400 feet, giving a slope of about 38 feet per mile in this distance. From the state line to Connellsville the fall is at the rate of approximately 17 feet per mile, and from Connellsville to the mouth, 43 miles, the rate is 3.5 feet per mile. Between Ohiopyle and Connellsville, a distance of 17.5 miles, the rate of fall is 19 feet per mile, reaching at Ohiopyle Falls a rate of over 50 feet per mile.

The principal tributaries of the Youghiogheny river in Pennsylvania are Big Sewickley creek, Indian creek and the Casselman river. There are many tributaries in Maryland and West Virginia, the principal being Bear creek, Deep creek, Little Youghiogheny and Rhine creeks.

The headwaters of this stream and the basin of it as far down as Connellsville is sparsely inhabited, well covered with second growth timber, with some farming and coal mining carried on. From Connellsville to the mouth the watershed is densely inhabited, especially in the valleys, which are industrially very active, the surrounding hills being practically deforested, while considerable farming is carried on. The region is the center of the vast bituminous coal producing and coke making belt and the streams are laden with mine water and sulphur. Four large boroughs and many large villages lie in this area, some of the communities obtaining a domestic water supply from the stream.

Navigation on the Youghiogheny river was at one time improved by the construction of dams and locks, from McKeesport, at its mouth, to West Newton, 19 miles above. Since 1868, however, this navgiation has been abandoned, and all dams and locks removed from the river.

The mean annual precipitation over the lower portion of this watershed is from 35 to 40 inches, the central portion from 45 to 50 inches, while the upper portion is subject to a rainfall of from 40 to 45 inches.

Gaging Station on Youghiogheny River, at Confluence.

The discharge has been measured at Friendsville, Md., Confluence, Pa., and at Connellsville, Pa., since August 17, 1898, September 15, 1904, and July 22, 1908, respectively, the former, however, being discontinued on December 31, 1904.

OHIO BASIN—STATION NO. 28.

YOUGHIOGHENY RIVER AT CONFLUENCE, PA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on September 15th, 1904. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania, which has been operating it since that date. It is located on a two-span, steel, highway bridge, about one-fourth to one-half mile from the railroad station at Confluence.

The channel is straight for 200 feet above and 500 feet below the station. The right bank is high and does not overflow, while the left bank is low and overflows during high water. The bed is rocky and there are two channels at all stages. There is a small cobble stone dam from four to six inches high under the bridge.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is center of bridge pin over right abutment on upstream side of bridge.

A standard chain gage is fastened to the downstream handrail of the bridge. The length of chain from the bottom of weight to the marker is 23.19 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a cross on head of rivet in bed plate at right abutment on downstream side; elevation 20.53 feet above gage datum. Bench Mark No. 2 is a cross on lower chord of bridge under the gage box; elevation, 20.28 feet above gage datum. The gage is read once daily by Lloyd L. Mountain.

Since the establishment of this station, 21 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission.

DISCHARGE MEASUREMENTS OF YOUGHIOGHENY RIVER, AT CONFLUENCE, SOMERSET COUNTY, PA.

(Drainage area 435 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
21	1912 Dec. 4	Boehringer, ...	200	285	1.45	2.50	414	0.6 measurement.

DISCHARGE TABLE FOR YOUGHIOGHENY RIVER, AT CONFLUENCE, SOMERSET COUNTY, FROM SEPT. 15, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.00	....	.40	1335	.70	5530	10.00	10150	.30	14770
.10	16	.50	1420	.80	5670	.10	10290	.40	14910
.15	19	.60	1510	.90	5810	.20	10430	.50	15050
.20	23	.70	1600	7.00	5950	.30	10570	.60	15190
.25	28	.80	1695	.10	6090	.40	10710	.70	15330
.30	35	.90	1795	.20	6230	.50	10850	.80	15470
.35	42	4.00	1900	.30	6370	.60	10990	.90	15610
.40	50	.10	2005	.40	6510	.70	11130	14.00	15750
.45	60	.20	2110	.50	6650	.80	11270	.10	15890
.50	70	.30	2225	.60	6790	.90	11410	.20	16030
.55	81	.40	2340	.70	6930	11.00	11550	.30	16170
.60	94	.50	2460	.80	7070	.10	11690	.40	16310
.65	108	.60	2580	.90	7210	.20	11830	.50	16450
.70	124	.70	2710	8.00	7350	.30	11970	.60	16590
.75	140	.80	2850	.10	7490	.40	12110	.70	16730
.80	160	.90	2990	.20	7630	.50	12250	.80	16870
.85	180	5.00	3135	.30	7770	.60	12390	.90	17010
.90	202	.10	3276	.40	7910	.70	12530	15.00	17150
.95	225	.20	3417	.50	8050	.80	12670	.10	17290
2.00	250	.30	3558	.60	8190	.90	12810	.20	17430
.10	308	.40	3700	.70	8330	12.00	12950	.30	17570
.20	370	.50	3842	.80	8470	.10	13090	.40	17710
.30	441	.60	3984	.90	8610	.20	13230	.50	17850
.40	518	.70	4126	9.00	8750	.30	13370	.60	17990
.50	595	.80	4268	.10	8890	.40	13510	.70	18130
.60	672	.90	4409	.20	9030	.50	13650	.80	18270
.70	750	6.00	4550	.30	9170	.60	13790	.90	18410
.80	830	.10	4690	.40	9310	.70	13930	16.00	18450
.90	910	.20	4830	.50	9450	.80	14070		
3.00	995	.30	4970	.60	9590	.90	14210		
.10	1080	.40	5110	.70	9730	13.00	14350		
.20	1165	.50	5250	.80	9870	.10	14490		
.30	1250	.60	5390	.90	10010	.20	14630		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF YOUGHIOGHENY RIVER AT CONFLUENCE, SOMERSET COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	5.80	4270	....	1040	4.00	1900	4.50	2460	4.05	1950	2.30	441	4.15	2060	3.39	1330	2.98	986	3.12	1100	2.16	345	2.01	256
2, ...	4.80	2850	....	1040	3.70	1600	4.30	2220	3.90	1800	2.20	370	3.85	1740	3.04	1080	4.83	2890	2.92	927	2.16	345	2.06	285
3, ...	4.05	1950	....	1040	3.50	1420	4.20	2110	3.70	1600	2.10	308	3.70	1600	2.84	862	5.43	3740	2.77	806	2.11	314	2.56	641
4, ...	3.70	1600	....	1040	3.25	1210	4.10	2000	3.65	1560	2.00	250	3.65	1560	2.69	742	4.78	2750	2.62	688	2.11	314	2.46	564
5, ...	3.40	1340	....	1040	3.10	1080	3.85	1740	3.45	1380	2.05	279	3.90	1800	2.59	664	4.33	2260	2.52	610	2.06	285	2.41	526
6, ...	3.15	1120	....	1040	3.00	995	3.85	1740	3.35	1290	1.95	225	3.50	1420	2.49	587	4.08	1980	2.42	533	2.06	285	3.80	1700
7, ...	3.00	995	....	1040	3.00	995	3.70	1600	3.30	1250	1.95	225	3.05	1040	2.44	549	3.88	1720	2.32	456	3.61	1520	3.90	1800
8, ...	2.95	952	....	1040	3.20	1160	3.60	1510	3.10	1080	1.95	225	2.80	830	2.39	510	3.53	1450	2.22	384	5.16	3360	3.40	1340
9, ...	2.95	952	....	1040	3.90	1800	3.50	1420	3.10	1080	1.90	202	2.65	711	2.29	434	3.33	1280	2.12	320	4.01	1910	3.15	1120
10, ...	3.05	1040	....	1040	3.40	1340	3.30	1250	3.05	1040	1.95	225	2.65	711	2.44	549	3.13	1110	2.12	320	3.31	1260	2.95	952
11, ...	3.70	1600	....	1040	3.30	1250	3.30	1250	2.95	952	1.85	180	3.00	995	2.34	472	2.83	854	2.12	320	3.06	1050	2.70	750
12, ...	3.45	1380	....	1040	3.35	1290	3.20	1160	2.95	952	1.85	180	4.20	2110	2.24	398	2.68	695	2.12	320	2.96	961	2.50	595
13, ...	3.15	1120	....	1040	3.20	1160	3.10	1080	2.85	870	1.80	160	3.20	1160	2.19	364	2.48	580	2.12	320	2.86	878	2.35	480
14, ...	3.15	1120	....	1040	3.10	1080	3.00	995	2.85	870	1.80	160	2.80	830	2.24	398	2.33	464	2.07	291	2.96	961	2.35	480
15, ...	3.20	1160	...	1040	a11.32	12000	2.90	910	2.80	830	1.95	225	2.60	672	2.44	549	2.23	391	2.07	291	2.81	838	2.40	518
16, ...	3.15	1120	....	1040	9.55	9520	2.95	952	8.25	7700	4.95	3060	3.45	1380	2.39	510	2.23	391	2.07	291	2.71	758	2.40	518
17, ...	*	1120	....	1040	6.10	4690	2.90	910	6.10	4690	3.95	1850	3.75	1650	2.34	472	2.23	391	2.02	262	2.61	680	2.40	518
18, ...	......	1120	....	1040	5.50	3840	3.70	1600	4.95	3060	3.05	1040	3.55	1460	2.34	472	2.23	391	2.02	262	2.56	641	2.50	595
19, ...	......	1120	....	1040	5.30	3560	3.90	1800	4.80	2850	2.65	711	3.35	1290	2.34	472	2.18	358	2.02	262	2.46	564	2.80	880
20, ...	......	1120	....	1040	7.15	6160	3.50	1420	4.45	2400	2.50	595	3.15	1130	3.24	1200	2.18	358	1.97	236	2.41	526	3.00	995
21, ...	......	1120	....	1040	15.30	17600	3.40	1340	4.20	2110	2.35	480	4.40	2340	2.69	742	2.18	358	1.97	236	2.36	487	2.90	910
22, ...	......	1120	....	1040	10.25	10600	3.20	1160	4.05	1950	2.25	406	6.35	5040	2.69	742	2.23	391	1.97	236	2.31	449	2.80	880
23, ...	......	1120	....	1040	6.50	5250	3.10	1080	3.85	1740	2.30	441	4.15	2060	2.64	708	3.68	1580	2.32	456	2.26	413	2.85	870
24, ...	......	1120	....	1040	7.50	6650	3.00	995	3.60	1510	2.50	595	14.95	17100	2.59	664	6.93	5850	2.72	766	2.21	377	2.50	595
25, ...	......	1120	....	1040	6.60	5390	2.90	910	3.35	1290	2.55	634	10.65	11100	2.54	626	5.08	3130	2.72	766	2.16	345	2.25	406
26, ...	......	1120	....	10000	5.50	3840	2.90	910	3.10	1080	2.75	790	6.20	4880	2.49	587	4.33	2260	2.82	846	2.11	314	2.00	250
27, ...	......	1120	9.60	9590	5.20	3420	3.10	1080	3.00	995	2.65	711	4.85	2920	2.44	549	5.23	3460	2.67	727	2.11	314	2.10	308
28, ...	......	1120	6.00	4550	4.90	2990	4.30	2220	2.75	790	2.50	595	4.05	1950	2.44	549	4.43	2380	2.52	610	2.06	285	2.40	518
29, ...	......	1120	4.60	2580	5.85	4340	4.00	1900	2.70	750	2.55	634	3.75	1650	2.89	902	3.83	1720	2.37	495	2.01	256	2.65	711
30, ...	......	1120	....	......	5.10	3280	4.40	2340	2.50	595	4.70	2710	4.80	2850	3.09	1070	3.43	1360	2.27	420	2.01	256	4.50	2460
31, ...	......	1120	....	......	4.90	2850	....	......	2.45	556	....	......	3.70	1600	2.94	944	....	......	2.17	351	....	......	5.70	4130

*Ice gorge at Casselman River causing backwater. Daily discharge Jan. 17-Feb. 26, inclusive, estimated from Youghiogheny River at Connellsville. a Max. 11.75 ft.=12600 sec. ft. during night of 15th.

ESTIMATED MONTHLY DISCHARGE OF YOUGHIOGHENY RIVER AT CONFLUENCE, SOMERSET COUNTY, PA.

(Drainage area 435 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	1330	3.067	3.524
February,	....	....	1820	4.184	4.512
March,	12600	995	4010	9.218	10.628
April,	3460	910	1470	3.379	3.770
May,	7700	556	1700	3.908	4.506
June,	3060	160	630	1.448	1.616
July,	17100	672	2570	5.908	6.812
August,	1330	364	666	1.531	1.765
September,	5850	358	1580	3.632	4.052
October,	1100	236	481	1.106	1.275
November,	3300	256	710	1.632	1.821
December,	4130	250	886	2.037	2.348
The year,	....	....	1490	3.420	46.539

Note.—On account of ice gorge from Jan. 17-Feb. 26, inclusive, daily discharge estimated from Youghiogheny River at Connellsville.

CASSELMAN RIVER.

DESCRIPTION OF BASIN.

The Casselman river, the largest tributary of the Youghiogheny river, drains an area of approximately 578 square miles, of which 480 lie in Pennsylvania and 98 in Maryland. Rising in two branches, the North and the South, in Garrett county, Maryland, which join in the above county about four miles south of the Mason and Dixon line, the stream flows northeasterly into Pennsylvania at Meyersdale, Somerset county, where it turns northwesterly to Rockwood and thence southwesterly to the Youghiogheny river, at Confluence, Somerset county, Pa. The North and South Branches respectively, are 13 and 8 miles long, and the main river, from their junction to its mouth, is 23 miles in length. Its course through Maryland and the southern part of Somerset county, Pa., lies through a fertile, rolling valley, between Negro and Meadow mountains, whose average width is about six miles. From Meyersdale to its mouth, the course of the stream becomes more confined, and the valley is steep and grows deeper toward its mouth. This river has a rapid fall throughout practically its entire length. The principal tributary is Laurel Hill creek, which enters the river just above its confluence with the Youghiogheny river. The valleys are largely under cultivation, while the hillsides and mountain tops are covered with second growth timber.

There are numerous small boroughs and villages in this drainage basin. Bituminous coal is being extensively mined, and with farming, is the principal industry. The drainage basin has been virtually deforested, but is rapidly being covered with second growth. A few of the tributaries of the Casselman river are used as sources for domestic supply.

The mean annual precipitation over this watershed is between 40 and 45 inches.

The discharge has been measured sinced September 15th, 1904, at Confluence, about one mile above the mouth.

OHIO BASIN—STATION NO. 29.

CASSELMAN RIVER AT CONFLUENCE, PA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on September 15th, 1904. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania, which has been operating it since that date. It is located on a two-span, steel highway bridge, about 500 yards from the railroad station at Confluence.

The channel is straight for 200 feet above and 500 feet below the station. The right bank is high and not subject to overflow, while the left bank is low and overflows during extreme high water. bed is covered with boulders, with some vegetation. There are two channels at all stages and the current is swift.

Discharge measurements are taken from the upstream side of the bridge. The initial point for soundings is center of bridge pin over right abutment on upstream side.

A standard chain gage is fastened to the upstream handrail. The length of chain from the bottom of the weight to the marker is 21.40 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a chiselled draft marked with paint on the right abutment on the downstream side; elevation 17.88 feet above gage datum. Bench Mark No. 2 is a cross on the top of lower chord of bridge near gage;

elevation, 18.61 feet above gage datum. Bench Mark No. 3 is on the upstream wingwall, right abutment, on natural shelf in 10th course from top, 1.7 feet in from corner of wingwall and face of abutment, and 0.4 feet down from top of course; elevation 6.68 feet above gage datum. The gage is read once daily by Lloyd L. Mountain.

This station is of value chiefly for low water measurements as the discharge values for high gage readings are liable to be considerably in error owing to frequent backwater from the Youghiogheny river.

Since the establishment of this station, 23 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Commission of Pennsylvania.

DISCHARGE MEASUREMENTS OF CASSELMAN RIVER, AT CONFLUENCE, SOMERSET COUNTY, PA.

(Drainage area 450 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
23	Dec. 4,	Boehringer, ...	217	325	1.32	2.48	429	0.6 msmt.

DISCHARGE TABLE FOR CASSELMAN RIVER, AT CONFLUENCE, SOMERSET COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.30	8	2.00	230	.70	780	.40	1495	.10	2300
.40	20	.10	280	.80	875	.50	1605	.20	2420
.50	37	.20	350	.90	970	.60	1720	.30	2540
.60	61	.30	430	3.00	1070	.70	1835	.40	2660
.70	93	.40	510	.10	1175	.80	1950	.50	2785
.80	130	.50	600	.20	1280	.90	2065	.60	2910
.90	170	.60	690	.30	1385	4.00	2180	.70	3035

BACKWATER DISCHARGE TABLE FOR CASSELMAN RIVER, AT CONFLUENCE, SOMERSET COUNTY, FROM JANUARY 1, 1912.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
4.00	2175	.90	4560	.80	8390	.70	12335	.60	16265
.10	2275	7.00	4680	.90	8525	.80	12465	.70	16400
.20	2370	.10	4800	10.00	8660	.90	12600	.80	16540
.30	2460	.20	4925	.10	8795	13.00	12735	.90	16675
.40	2550	.30	5050	.20	8930	.10	12870	16.00	16810
.50	2630	.40	5170	.30	9065	.20	13005	.10	16945
.60	2705	.50	5290	.40	9205	.30	13140	.20	17080
.70	2780	.60	5420	.50	9340	.40	13280	.30	17215
.80	2850	.70	5545	.60	9475	.50	13415	.40	17355
.90	2920	.80	5675	.70	9610	.60	13550	.50	17490
5.00	2990	.90	5810	.80	9745	.70	13685	.60	17625
.10	3060	8.00	5950	.90	9880	.80	13820	.70	17760
.20	3125	.10	6080	11.00	10020	.90	13955	.80	17895
.30	3190	.20	6220	.10	10155	14.00	14095	.90	18030
.40	3255	.30	6355	.20	10290	.10	14230	17.00	18170
.50	3320	.40	6490	.30	10425	.20	14365	.10	18305
.60	3375	.50	6625	.40	10560	.30	14500	.20	18440
.70	3430	.60	6760	.50	10695	.40	14635	.30	18575
.90	3500	.70	6895	.60	10835	.50	14770	.40	18710
.90	3570	.80	7030	.70	10970	.60	14910	.50	18845
6.00	3640	.90	7165	.80	11105	.70	15045	.60	18985
.10	3710	9.00	7300	.90	11240	.80	15180	.70	19120
.20	3780	.10	7435	12.00	11375	.90	15315	.80	19255
.30	3875	.20	7575	.10	11510	15.00	15450	.90	19390
.40	3970	.30	7710	.20	11650	.10	15585	18.00	19525
.50	4080	.40	7845	.30	11785	.20	15725	.10	19660
.60	4200	.50	7980	.40	11920	.30	15860		
.70	4320	.60	8115	.50	12055	.40	15995		
.80	4440	.70	8250	.60	12190	.50	16130		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF CASSELMAN RIVER AT CONFLUENCE, SOMERSET COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	4.80	2910	....	1050	......	2100	3.85	2010	4.00	2180	2.30	430	3.25	1330	2.60	690	3.00	1070	3.80	1950	2.20	350	2.10	280
2, ...	4.04	2120	....	1050	......	2100	3.70	1840	3.85	2010	2.20	350	2.90	970	2.50	600	4.50	2630	3.50	1600	2.20	350	2.20	350
3, ...	3.64	1770	....	1050	......	2100	3.55	1660	3.70	1840	2.10	280	2.80	875	2.40	510	7.20	4920	3.10	1180	2.15	315	2.60	690
4, ...	3.34	1430	....	1050	......	2100	3.45	1550	3.60	1720	2.00	220	2.70	780	2.35	470	4.70	2780	2.90	970	2.15	315	2.40	510
5, ...	3.04	1110	....	1050	......	2100	3.30	1380	3.50	1600	2.00	220	2.70	780	2.30	430	4.10	2280	2.70	780	2.15	315	2.40	510
6, ...	....	800	....	1050	......	2100	3.20	1280	3.40	1500	1.95	195	3.05	1130	2.25	390	3.90	2060	2.60	690	3.10	280	3.25	1330
7, ...	....	800	....	1050	......	2100	3.10	1130	3.30	1380	1.95	195	2.75	828	2.25	390	3.80	1950	2.50	600	4.10	2300	3.10	1180
8, ...	..	800	....	1050	......	2100	3.00	1070	3.10	1180	1.95	195	2.55	645	2.20	350	3.55	1660	2.40	510	4.85	2600	2.80	875
9, ...	....	800	....	1050	......	2100	2.90	970	3.00	1070	1.90	170	2.40	510	2.10	280	3.40	1500	2.30	430	3.40	1500	2.55	645
10, ...	....	800	....	1050	......	2100	2.85	922	2.95	1020	1.90	170	2.35	470	2.30	430	3.25	1330	2.30	430	3.20	1280	2.40	510
11, ...	....	800	....	1050	......	2100	2.80	875	2.90	970	1.85	150	2.50	600	2.20	350	2.95	1020	2.30	430	3.00	1070	2.30	430
12, ...	...	800	....	1050	......	2100	2.75	828	2.85	922	1.85	150	2.40	510	2.15	315	2.75	828	2.25	390	2.80	875	2.20	350
13, ...	....	800	....	1050	......	2100	2.70	780	2.85	922	1.80	130	2.30	430	2.10	280	2.65	735	2.25	390	2.70	780	2.15	315
14, ...	....	800	....	1050	......	2100	2.65	735	2.80	875	1.80	130	2.20	350	2.20	350	2.55	645	2.20	350	2.90	970	b2.25	390
15, ...	....	800	....	1050	......	2100	2.65	735	2.80	875	2.20	350	2.10	280	2.55	645	2.50	600	2.20	350	2.75	828	2.40	510
16, ...	....	800	....	1050	......	2100	2.60	690	7.80	5680	6.20	3780	4.00	2180	2.45	555	2.45	555	2.15	315	2.65	735	2.40	510
17, ...	....	800	....	1050	......	2100	2.60	690	5.00	2990	3.20	1280	3.20	1280	2.40	510	2.45	555	2.15	315	2.60	690	2.35	470
18, ...	...	800	....	1050	......	2100	3.70	1840	4.10	2280	2.80	875	3.00	1070	2.50	600	2.45	555	2.10	280	2.55	645	2.35	470
19, ...	†	800	....	1050	......	2100	3.30	1380	3.90	2060	2.70	780	2.80	875	2.60	690	2.40	510	2.10	280	2.50	600	2.65	735
20, ...	....	800	....	1050	......	2100	3.00	1070	3.75	1890	2.60	690	2.70	780	4.50	2780	2.40	510	2.05	250	2.45	555	2.60	690
21, ...	....	800	....	1050	17.00	18200	2.75	828	3.60	1720	2.50	600	4.40	2550	3.65	1780	2.35	470	2.05	250	2.40	510	2.40	510
22, ...	....	800	....	1050	9.60	8120	2.75	828	3.50	1600	2.45	555	6.00	3640	3.55	1660	2.40	510	2.05	250	2.35	470	2.25	390
23, ...	‡	800	....	1050	5.65	3400	2.75	828	3.40	1500	2.40	510	3.80	1950	3.45	1550	3.50	1600	3.20	1280	2.25	390	2.15	315
24, ...	.. .	800	....	1050	7.00	4680	2.70	780	3.20	1280	2.45	555	12.75	12400	3.35	1440	6.85	4500	2.75	828	2.25	390	2.10	280
25, ...	....	800	....	1050	5.60	3380	2.70	780	3.10	1180	2.40	510	9.15	7500	3.30	1380	4.70	2780	2.70	780	2.20	350	2.10	280
26, ...	....	800	....	1050	4.90	2920	2.65	735	2.95	1020	2.50	600	4.85	2880	3.25	1330	4.30	2460	2.60	690	2.20	350	2.20	350
27, ...	a	800	....	1050	4.70	2780	2.70	780	2.80	875	2.35	470	3.70	1840	3.20	1280	5.30	3190	2.55	645	2.15	315	2.20	350
28, ...	...	800	....	1050	4.60	2700	3.60	1720	2.60	690	2.25	390	3.20	1280	3.15	1230	4.80	2860	2.45	555	2.15	315	2.30	430
29, ...	....	800	....	1050	5.60	3380	3.30	1380	2.60	690	2.40	510	3.10	1180	3.45	1550	4.40	2550	2.35	470	2.10	280	2.35	470
30, ...	....	800	....	......	5.05	3020	4.60	2910	2.50	600	4.20	2420	3.10	1180	3.30	1380	4.10	2280	2.25	390	2.10	280	3.35	1440
31, ...	....	800	....	......	4.05	2220	....	......	2.40	510	....	......	2.75	828	3.10	1180	....	......	2.20	350	....	......	4.70	3085

On account of ice conditions the daily discharge for Jan. 6 to March 20, inclusive, was estimated from Youghiogheny River at Connellsville and climatological records. †Ice went out about 11:00 a. m., and gorged below the confluence, backing up water. ‡Channel open through gorge. a Channel frozen and starting to gorge. b Ice on shores.

ESTIMATED MONTHLY DISCHARGE OF CASSELMAN RIVER AT CONFLUENCE, SOMERSET COUNTY.

(Drinage area 450 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	972	2.160	2.490
February,	....	....	1050	2.333	2.516
March,	18200	....	3120	6.933	7.993
April,	2910	690	1170	2.600	2.901
May,	5680	510	1500	3.333	3.843
June,	3780	130	595	1.322	1.475
July,	12400	280	1740	3.867	4.458
August,	2780	230	883	1.962	2.262
September,	4920	470	1730	3.844	4.288
October,	1950	250	612	1.360	1.568
November,	2600	280	700	1.556	1.736
December,	3035	280	632	1.404	1.619
The year,	....	....	1225	2.723	37.149

Note.On account of ice conditions the daily discharge from Jan. 6 to March 20, inclusive, was estimated from Youghiogheny River at Connellsville and climatological records.

LAUREL HILL CREEK.

DESCRIPTION OF BASIN.

Laurel Hill creek, in Somerset and Fayette counties, the principal tributary of the Casselman river, drains an area of approximately 125 square miles. Rising in the southeastern corner of Jefferson township, Somerset county, this stream flows northward a short distance, and then, describing a semi-circle, turns southward, through a hilly farming country, almost deforested and underlain with bituminous coal, to its mouth at Confluence, a distance of about 30 miles. There are many tributaries to this stream, none of which, however, drain an area of more than seven or eight square miles, the watershed being an approximate parallellogram seven miles in width and about 17 miles in length. One borough and numerous farming villages are located on this basin. A few private water supplies are obtained from this watershed.

The mean annual precipitation over this watershed is from 40 to 45 inches.

The discharge has been measured since September 15th, 1904, at Confluence, near its mouth.

LAUREL HILL CREEK AT CONFLUENCE, PA.

DESCRIPTION OF STATION.

This station was established by the United States Geological Survey on September 15th, 1904. On April 1st, 1907, this station was taken over by the Water Supply Commission of Pennsylvania, which has been operating it since that date. It is located on a single span, steel highway bridge, near a tannery, one-fourth mile from the railroad station at Confluence.

The channel is straight for 25 feet above and 300 feet below the station. The right bank is low and clean, but subject to overflow during high water, while the left bank is high and does not overflow. The bed is composed of rough cobble stones and is permanent. The current is swift. In September, 1908, the creek was practically dry.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is center of bridge pin over left abutment on left side of bridge.

A standard chain gage is fastened to the downstream handrail of the bridge. The length of chain from the bottom of weight to the marker is 17.40 feet. The elevation of zero is arbitrary datum. Bench Mark No. 1 is a cross on top of bolt in bed plate of bridge at right abutment; elevation, 14.16 feet above gage datum. Bench Mark No. 2 is a cross on lower chord of bridge under gage box; elevation, 14.71 feet above gage datum. The gage is read once daily by Lloyd L. Mountain.

This station is of value chiefly for low water measurements as the discharge values from high gage readings are liable to be considerably in error owing to frequent backwater from the Youghiogheny and Casselman rivers, and the discharge above gage height 4.7 feet has not been published for this reason.

Since the establishment of this station, 21 discharge measurements have been made. The data prior to 1912 will be found in the 1910-11 Report of the Water Supply Comission.

DISCHARGE MEASUREMENTS OF LAUREL HILL CREEK, AT CONFLUENCE, SOMERSET COUNTY, PA.

(Drainage area 126 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
21	1913 Dec. 4,	Boehringer, ...	91.6	149	0.99	2.17	147	0.6 measurement.

DISCHARGE TABLE FOR LAUREL HILL CREEK AT CONFLUENCE, SOMERSET COUNTY, FROM SEPT. 16, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
1.40	1	.10	95	.80	425	.50	835	.20	1165
.50	4	.20	130	.90	495	.60	885	.30	1210
.60	8	.30	170	3.00	560	.70	935	.40	1255
.70	16	.40	210	.10	625	.80	985	.50	1295
.80	26	.50	260	.20	680	.90	1030	.60	1335
.90	41	.60	310	.30	735	4.00	1075	.70	1375
2.00	62	.70	365	.40	785	.10	1120		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF LAUREL HILL CREEK AT CONFLUENCE, SOMERSET COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	3.80	965	....	300	......	580	3.15	652	3.55	860	2.09	92	2.83	446	2.41	215	2.80	425	2.88	481	2.27	158	1.87	36
2, ...	3.30	735	....	300	......	580	3.15	652	3.40	785	2.04	75	2.43	225	2.31	174	4.40	1260	2.68	354	2.27	158	1.97	56
3, ...	3.05	595	....	300	......	580	3.05	592	3.30	735	1.94	49	2.43	225	2.21	134	6.65	......	2.53	275	2.22	138	2.32	178
4, ...	2.90	495	....	300	......	580	3.00	560	3.20	680	1.89	40	2.33	182	2.11	98	4.40	1260	2.43	225	2.17	112	2.02	69
5, ...	2.70	365	....	300	......	580	2.90	495	3.20	680	1.89	40	2.63	326	2.01	65	4.00	1080	2.38	202	2.12	102	2.20	130
6, ...	2.60	310	....	300	......	580	2.85	460	3.05	592	1.84	32	2.48	250	1.96	54	3.70	985	2.28	162	2.12	102	3.00	560
7, ...	2.50	260	....	300	......	580	2.85	460	2.95	528	1.84	32	2.33	182	1.96	54	3.60	885	2.28	142	3.27	718	2.80	425
8, ...	....	220	....	300	......	580	2.75	395	2.90	495	1.84	32	2.23	142	1.91	43	3.40	785	2.13	106	3.47	820	2.55	285
9, ...	....	220	....	300	......	580	2.80	425	2.85	460	1.79	25	2.18	123	1.91	43	3.20	680	2.03	72	2.82	489	2.40	210
10, ...	....	220	....	300	......	580	2.70	365	2.85	460	1.79	25	2.13	106	1.91	43	3.05	592	2.03	72	2.72	377	2.30	170
11, ...	....	220	....	300	......	580	2.70	365	2.75	395	1.74	20	2.23	142	1.91	43	2.70	365	2.03	72	2.63	321	2.15	112
12, ...	....	220	....	300	......	580	2.70	365	2.70	365	1.74	20	2.13	106	1.86	35	2.60	310	2.03	72	2.52	270	2.05	78
13, ...	....	220	....	300	......	580	2.65	338	2.70	365	1.74	20	2.03	72	1.86	35	2.50	260	2.03	72	2.42	220	1.95	52
14, ...	....	220	....	300	......	580	2.65	338	2.65	338	1.74	20	1.98	58	2.11	98	2.40	210	1.98	58	2.57	295	†2.15	112
15, ...	....	220	....	300	......	580	2.60	310	2.70	365	1.94	49	1.93	47	2.51	265	2.30	170	1.98	58	2.42	220	2.30	170
16, ...	....	220	....	300	......	580	2.55	285	6.75	......	4.94	......	3.28	724	2.81	174	2.30	170	1.98	58	2.32	178	2.20	130
17, ...	....	220	....	300	......	580	2.60	310	4.65	1360	3.04	586	2.93	519	2.11	98	2.30	170	1.93	47	2.27	158	2.10	95
18, ...	....	220	....	300	......	580	3.35	760	3.55	860	2.64	332	2.73	383	2.31	174	2.25	150	1.93	47	2.22	138	2.10	95
19, ...	*	220	....	300	......	580	3.10	625	3.40	785	2.54	280	2.53	275	2.51	265	2.25	150	1.88	33	2.22	138	2.60	310
20, ...	....	220	....	300	......	580	2.85	460	3.30	735	2.44	280	2.53	275	3.06	915	2.25	150	1.88	33	2.17	112	2.40	210
21, ...	....	220	....	300	14.40	......	2.70	365	3.15	652	2.39	206	3.93	1040	3.56	865	2.25	150	1.83	30	2.12	102	2.25	150
22, ...	....	220	....	300	7.20	......	2.75	395	3.05	592	2.44	230	4.63	1350	3.41	790	2.40	210	1.83	30	2.12	102	2.15	112
23, ...	....	220	....	300	4.15	1140	2.70	365	3.00	560	2.34	186	3.13	642	3.31	740	5.15	......	3.23	696	2.07	85	2.05	78
24, ...	....	220	....	300	5.00	......	2.70	365	2.90	495	2.19	126	9.98	......	3.21	686	5.80	......	2.98	514	2.07	85	2.05	78
25, ...	....	220	....	300	4.20	1160	2.65	338	2.85	460	2.14	109	6.18	......	3.11	630	4.25	1190	2.88	481	2.02	69	2.00	62
26, ...	....	220	....	300	3.80	985	2.60	310	2.65	338	2.29	166	3.58	875	3.01	566	4.00	1080	2.83	446	2.02	69	2.00	62
27, ...	....	220	....	300	3.50	835	2.70	365	2.45	235	2.24	146	3.13	642	2.91	502	4.90	......	2.73	383	1.97	56	2.00	62
28, ...	....	220	....	300	3.40	785	3.45	810	2.35	190	2.19	126	2.98	514	2.91	502	3.80	985	2.68	326	1.92	45	2.05	78
29, ...	....	220	....	300	4.05	1100	3.20	680	2.25	150	2.29	166	2.83	446	3.21	686	3.30	735	2.58	275	1.92	45	2.20	130
30, ...	....	220	....	......	3.55	860	3.95	1050	2.20	130	3.19	674	2.83	446	2.91	502	3.00	560	2.43	225	1.92	45	4.25	1190
31, ...	....	220	....	......	3.40	785	....	......	2.20	130	....	......	2.53	275	2.81	482	....	......	2.38	182	....	......	3.55	860

*Back water from gorge on Casselman River. On account of ice conditions the daily discharge from Jan. 8-March 20, inclusive, estimated from Youghiogheny River at Connellsville and climatological records. †Ice along shores.

ESTIMATED MONTHLY DISCHARGE OF LAUREL HILL CREEK, AT CONFLUENCE, SOMERSET COUNTY.

(Drainage area 126 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	....	....	291	2.310	2.663
February,	....	....	300	2.381	2.563
April,	....	285	475	3.770	4.206
May,	....	130	....	....	....
June,	....	20	....	....	....
July,	....	47	....	....	....
August,	....	35	320	2.540	2.928
September,	....	150	....	....	....
October,	....	30	201	1.595	1.839
November,	....	45	196	1.556	1.736
December,	....	36	205	1.627	1.876

Note.—On account of ice conditions the daily discharge from Jan. 8-March 20, inclusive, estimated from Youghiogheny River at Connellsville and climatological records. All gage heights above 4.7 ft. subject to backwater, and, therefore, no data above this gage height has been published.

OHIO BASIN—STATION NO. 31.

YOUGHIOGHENY RIVER AT CONNELLSVILLE, PA.

DESCRIPTION OF STATION.

This station was established by the Water Supply Commission of Pennsylvania on July 22nd, 1908, and is located on a two-span, steel, through truss, highway bridge on the road from Connellsville to New Haven.

The channel above the station is straight for one-half mile, with riffles 600 feet upstream, while the channel below the station is straight for 600 feet with riffles 600 to 800 feet downstream. A railroad bridge crosses the river 500 feet below. The right bank is high and does not overflow, the B. & O. tracks and retaining wall being along this side of the stream. The left bank is high and does not overflow. The bed is composed of rocks, gravel and mud and is permanent.

Discharge measurements are taken from the downstream side of the bridge and by wading during extreme low water at a section 600 feet above the B. & O. pumping station which is about one mile above the bridge on the right bank. The initial point for soundings on the first span is a point on the downstream handrail directly above face of concrete retaining wall at B. & O. tracks; on the second span at the bend in the handrail over the second pier.

A standard chain gage is bolted to the downstream handrail in the New Haven span. The length of the chain from the bottom of the weight to the low water marker is 34.21 feet, and to the high water marker 24.21 feet. The elevation of zero of the gage is 860.131 feet, U. S. G. S. levels. Bench Mark No. 1 is a chiselled point on projecting stone in retaining wall on New Haven side, below bridge, and is the lowest stone at this point. "B. M." chiselled into stone above. Elevation, 864.656 feet or 4.525 feet above gage datum. The gage is read twice daily by an employee of F. W. Scheidenhelm, Consulting Engineer, who co-operates in the maintenance of this station.

Since the establishment of this station, 16 discharge measurements have been made.

DISCHARGE MEASUREMENTS OF YOUGHIOGHENY RIVER, AT CONNELLSVILLE, FAYETTE COUNTY, PA.

(Drainage area 1,320 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
16	1912 Dec. 3,	Boehringer, ...	252	982	1.15	2.22	1129	Surface msmt.

DISCHARGE TABLE FOR YOUGHIOGHENY RIVER AT CONNELLSVILLE, FAYETTE COUNTY, FROM JULY 22, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.
0.00	....	.70	1715	.40	6590	.10	14530	.80	25000
.10	10	.80	1855	.50	6820	.20	14860	.90	25440
.20	20	.90	2000	.60	7050	.30	15200	11.00	25880
.30	35	3.00	2145	.70	7280	.40	15550	.10	26320
.40	55	.10	2305	.80	7520	.50	15920	.20	26760
.50	75	.20	2470	.90	7780	.60	16290	.30	27200
.60	100	.30	2640	6.00	8040	.70	16660	.40	27650
.70	130	.40	2810	.10	8300	.80	17030	.50	28100
.80	160	.50	2980	.20	8580	.90	17400	.60	28550
.90	200	.60	3150	.30	8860	9.00	17770	.70	29000
1.00	250	.70	3325	.40	9150	.10	18140	.80	29470
.10	300	.80	3500	.50	9450	.20	18510	.90	29960
.20	350	.90	3680	.60	9750	.30	18890	12.00	30450
.30	410	4.00	3860	.70	10055	.40	19270	.10	30950
.40	475	.10	4040	.80	10360	.50	19650	.20	31450
.50	545	.20	4220	.90	10665	.60	20040	.30	31950
.60	615	.30	4400	7.00	10970	.70	20440	.40	32450
.70	690	.40	4580	.10	11280	.80	20840	.50	32950
.80	770	.50	4770	.20	11590	.90	21240	.60	33500
.90	855	.60	4960	.30	11910	10.00	21640	.70	34050
2.00	950	.70	5155	.40	12230	.10	22040	.80	34600
.10	1045	.80	5350	.50	12550	.20	22450	.90	35150
.20	1145	.90	5545	.60	12880	.30	22860	13.00	35700
.30	1250	5.00	5740	.70	13210	.40	23270	.10	36300
.40	1360	.10	5950	.80	13540	.50	23690	.20	36850
.50	1470	.20	6160	.90	13870	.60	24120		
.60	1590	.30	6370	8.00	14200	.70	24560		

DAILY MEAN GAGE HEIGHTS AND DISCHARGES OF YOUGHIOGHENY RIVER AT CONNELLSVILLE, FAYETTE COUNTY, PA.

1912	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.	
DAY.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.	G H	Dis.
1, ...	6.97	10900	3.51	1480	4.51	4790	5.12	5980	5.59	7030	1.84	804	5.39	6570	3.21	2490	4.47	4710	3.39	2790	1.95	902	1.69	682
2, ...	5.71	7300	2.40	1360	3.57	3100	4.75	5250	4.71	5170	1.77	746	3.96	3790	2.88	1970	7.10	11300	3.16	2400	1.98	931	1.61	622
3, ...	4.69	5140	2.20	1140	3.16	2400	4.95	5640	4.14	4110	1.67	668	3.22	2500	2.85	1930	e8.34	15300	2.43	1390	1.92	874	2.09	1040
4, ...	4.19	4200	2.06	1010	3.13	2350	4.61	4980	3.66	3260	1.55	580	3.02	2180	2.63	1630	7.14	11400	2.56	1540	1.75	730	2.32	1270
5, ...	*3.41	2830	1.80	770	2.83	1960	4.08	4000	3.38	2780	1.53	566	3.04	2210	2.35	1300	5.24	6340	2.31	1260	1.68	675	2.05	998
6, ...	*2.69	1700	1.82	787	2.70	1720	3.80	3500	3.08	2270	1.55	580	3.34	2710	2.05	998	4.64	5040	2.29	1240	1.59	608	2.88	1970
7, ...	2.66	1660	1.95	902	2.74	1770	3.70	3320	3.03	2190	1.55	580	2.89	1990	1.95	902	3.92	3720	1.99	940	2.00	950	4.10	4040
8, ...	2.93	2040	2.00	950	2.83	1900	3.88	3640	3.51	3000	1.53	566	2.49	1460	1.88	838	3.50	2960	1.93	884	5.98	7990	3.50	2960
9, ...	2.80	1860	†1.85	812	3.76	3430	3.55	3060	3.29	2620	1.43	496	2.36	1320	1.78	714	3.27	2590	1.83	796	4.50	4770	3.06	2270
10, ...	2.69	1700	1.62	630	3.85	3590	3.19	2450	2.98	2120	1.34	436	2.79	1840	1.88	838	2.72	1740	1.86	821	3.80	3500	2.68	1690
11, ...	2.61	1600	1.68	675	3.06	2240	3.08	2270	2.77	1810	1.21	356	3.03	2180	1.98	931	2.42	1380	1.96	912	3.30	2640	2.65	1650
12, ...	2.61	1600	1.72	706	3.16	2400	2.90	2000	3.08	2270	1.16	330	3.26	2570	2.11	1060	2.22	1170	1.81	778	3.08	2270	2.40	1360
13, ...	†2.43	1390	1.70	690	4.23	4270	2.82	1880	4.51	4790	1.15	325	2.94	2060	2.27	1220	2.07	1020	1.63	638	2.75	1780	1.95	902
14, ...	2.13	1060	1.69	682	4.73	5210	3.00	2140	3.93	3730	1.10	300	2.24	1190	2.01	960	1.82	787	1.79	762	2.96	2070	1.80	770
15, ...	2.29	1240	1.56	580	8.15	14700	2.88	1970	3.54	3050	1.25	380	1.94	893	2.65	1650	1.90	855	1.51	552	2.90	2000	2.18	1120
16, ...	2.19	1140	1.68	675	10.40	23300	2.90	2000	6.20	8580	2.45	1420	2.04	988	2.18	1130	2.00	950	1.39	468	2.72	1740	2.35	1300
17, ...	2.03	978	1.65	652	7.35	12100	2.86	1940	7.50	12500	5.77	7450	3.54	3060	1.88	838	2.17	1130	1.43	496	2.55	1530	2.15	1100
18, ...	2.31	1260	1.70	690	6.51	9480	4.20	4220	6.00	8040	3.97	3810	3.94	3750	1.73	714	2.27	1220	1.31	416	2.40	1360	2.10	1040
19, ...	‡5.41	6610	1.89	846	6.08	8120	4.58	4920	4.89	5530	3.07	2260	4.59	4940	2.58	1570	3.34	2710	1.46	517	2.25	1200	2.48	1450
20, ...	5.09	5930	2.65	1650	7.50	12600	3.70	3320	4.28	4360	2.60	1590	3.36	2740	d6.33	8950	2.72	1740	1.46	517	2.14	1080	2.62	1620
21, ...	4.31	4420	4.15	4130	b16.03	f59200	3.42	2840	3.73	3380	2.35	1300	4.04	3980	4.45	4680	2.24	1100	1.51	552	2.10	1040	2.30	1250
22, ...	3.66	3260	4.71	5170	12.34	32200	3.21	2490	3.35	2720	2.27	1220	8.79	17000	3.55	3060	1.94	893	1.39	468	2.06	1010	2.12	1060
23, ...	3.76	3430	3.72	3360	8.20	14900	3.26	2570	3.08	2190	2.25	1200	5.99	8010	3.68	3290	2.52	1490	1.76	738	1.92	874	1.72	706
24, ...	3.86	3610	3.46	2910	7.90	13900	3.15	2390	2.77	1810	2.30	1250	8.31	15200	3.18	2440	6.77	10300	3.21	2490	1.90	855	1.85	812
25, ...	3.53	3080	3.20	2470	7.90	13900	2.96	2090	2.60	1590	2.50	1470	c11.28	27000	2.75	1780	6.52	9510	3.71	3340	1.90	855	1.80	770
26, ...	3.13	2350	5.48	6770	6.27	8780	2.93	2040	2.87	1930	2.70	1720	7.59	12800	2.68	1690	5.22	6200	3.69	3310	1.88	838	1.78	754
27, ...	2.96	2090	a11.76	29800	5.42	6640	4.54	4850	2.17	1120	2.70	1720	5.66	7190	2.71	1730	8.02	14300	3.31	2660	1.78	754	2.02	969
28, ...	2.51	1480	7.25	11800	4.80	5850	5.00	5740	2.08	978	2.23	1180	4.69	5140	2.13	1080	5.67	7210	2.71	1780	1.72	706	2.08	1030
29, ...	2.56	1540	5.51	6840	5.90	7780	4.44	4660	2.06	998	3.20	2470	3.84	3570	2.58	1570	5.22	6200	2.39	1350	1.55	580	1.92	874
30, ...	2.81	1870	......	......	7.18	11500	5.36	6500	2.33	1280	6.15	8440	3.99	3840	3.35	2720	4.07	3930	2.19	1140	1.60	615	3.35	2720
31, ...	2.63	1690	......	......	5.82	7570	....	....	2.10	1040	....	......	3.82	3540	3.13	2350	......	......	2.01	960	....	......	6.62	9810

*River freezing. †River partly frozen over. ‡Ice breaking up. a Max. 12.81 at 8:00 a. m.; 34700 sec. ft. b Max. 17.28 at 1:50 p. m.; f88000 sec. ft. c Max. 11.59 at 8:00 a. m.; 28500 sec. ft. d Max. 7.03 at 7:30 a. m.; 11100 sec. ft. e Max. 9.22 at 4:30 p. m.; 18600 sec. ft. f Estimated.

ESTIMATED MONTHLY DISCHARGE OF YOUGHIOGHENY RIVER AT CONNELLSVILLE, FAYETTE COUNTY.

(Drainage area, 1,320 square miles.)

MONTH.	Discharge in Second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1912.					
January,	10900	978	2930	2.220	2.559
February,	31700	580	3120	2.364	2.549
March,	f88000	1720	9780	7.409	8.542
April,	6500	1880	3490	2.644	2.950
May,	13500	978	3500	2.652	3.057
June,	8440	300	1540	1.167	1.302
July,	28500	893	5100	3.864	4.455
August,	11100	714	1900	1.439	1.659
September,	18600	787	4640	3.515	3.922
October,	3240	416	1250	0.947	1.092
November,	7990	580	1590	1.205	1.344
December,	9810	622	1630	1.235	1.424
The year,	f88000	300	3370	2.555	34.855

f Estimated.

MISCELLANEOUS DISCHARGE MEASUREMENTS.

The only miscellaneous discharge measurements made during 1912 were those taken at Frisco, near Ellwood City, Beaver county, on Connoquenessing creek, 18 of which were made on the creek proper, and 24 on the head race, the water in which is diverted from the creek about 200 feet above the gaging station. The gage heights given in these measurements are those recorded from permanent gages located on both the creek proper and the head race, the only use of which was to record the relative heights of water at the time the measurements were taken.

DISCHARGE MEASUREMENTS OF CONNOQUENESSING CREEK, (PROPER), AT WALKER'S MILL, NEAR ELLWOOD CITY, BEAVER COUNTY, PA.

(Drainage area 410 square miles.)

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
1	Feb. 20	Ross, ...	......	519	3.57	4.70	1853	
2	March 21	Ross, ...	142	959	8.23	8.12	7890	
3	March 22	Ross, ...	142	683	4.70	5.52	3210	
4	March 23	Ross, ...	142	564	3.70	4.84	2068	
5	March 23	Ross, ...	142	458	3.10	4.02	1422	
6	March 23	Ross, ...	150	456	3.09	4.02	1408	
7	April 2	Ross, ...	142	809	6.31	6.48	5107	
8	April 3	Ross, ...	143	877	6.34	6.90	5557	
9	April 8	Ross, ...	142	473	3.00	4.00	1417	
10	April 10	Ross, ...	142	367	2.29	3.88	841	
11	April 12	Ross, ...	142	295	1.78	2.93	525	
12	April 22	Ross, ...	127	225	1.35	2.48	308	
13	April 30	Ross, ...	142	803	6.06	6.45	4866	
14	April 30	Ross, ...	142	732	5.37	6.08	3932	
15	May 24	Ross, ...	123	157	0.99	1.90	155	
16	May 24	Ross, ...	117	110	0.93	1.55	102	
17	June 12	Ross, ...	82	58	0.44	1.05	25	
18	July 18	Ross, ...	123	190	1.33	2.15	252	

DISCHARGE MEASUREMENTS OF CONNOQUENESSING CREEK, (HEAD RACE), AT WALKER'S MILL, NEAR ELLWOOD CITY, BEAVER COUNTY, PA.

No.	Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.	
	1912							
1	Jan. 19	Ross, ...	15	78	0.99	2.00	77	Mill not running.
2	Feb. 20	Ross, ...	21	92	1.12	1.90	103	42" wheel running.
3	March 21	Ross, ...	22	99	0.79	2.10	79	Mill not running.
4	March 23	Ross, ...	21	69	0.33	1.70	23	Mill not running.
5	April 8	Ross, ...	21	93	0.71	1.95	66	Mill not running.
6	April 12	Ross, ...	20	76	1.03	1.15	78	40" wheel running.
7	April 12	Ross, ...	20	74	1.35	1.02	100	40" and 42" wheels running.
8	April 12	Ross, ...	20	78	0.46	1.22	36	Mill not running.
9	April 22	Ross, ...	20	76	0.07	1.05	5.3	Mill not running.
10	April 23	Ross, ...	20	74	0.78	0.94	58	42" wheel running.
11	April 22	Ross, ...	20	72	1.00	0.88	72	42" wheel open.
12	April 30	Ross, ...	22	96	0.53	1.95	50	Mill not running.
13	May 24	Ross, ...	20	67	0.76	0.60	51	42" wheel running.
14	May 24	Ross, ...	20	65	1.09	0.50	71	42" wheel open.
15	May 24	Ross, ...	20	61	1.64	0.25	100	Both wheels open.
16	June 12	Ross, ...	20	51	0.98	−0.30	50	42" wheel runing.
17	July 18	Ross, ...	20	71	0.82	0.72	58	42" wheel running.
18	July 18	Ross, ...	20	71	0.28	0.80	20	Mill not running.
19	July 26	Ross, ...	20	88	0.39	1.70	34	Mill not running.
20	July 26	Ross, ...	20	98	0.74	2.15	73	Mil not running. Gates open.
			20	94	0.61	1.95	57	
21	July 26	Ross, ...						Mill not running.
22	July 26	Ross, ...	20	79	0.13	1.15	10	Mill not running.
23	July 26	Ross, ...	20	78	0.24	1.40	19	Mill not running.
24	July 26	Ross, ...	20	84	0.38	1.70	32	Mill not running.

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